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Forthcoming Events.

JANUARY 22.

Institution of Production Engineers:—General meeting in London. "Features of Machine Tools which make for Increased Production," Paper by G. W. Rawlings.

West of Scotland Iron and Steel Institute:—Ordinary meeting at Glasgow. "Open Hearth Practice," Paper by Andrew M'Cance, D.Sc.

North-East Coast Institution of Engineers and Shipbuilders:—General meeting at Newcastle-on-Tyne. "Cast Iron for Internal-combustion Engines," Paper by A. Campion, F.I.C.

Institution of Mechanical Engineers:—Ordinary meeting at Sheffield. "Modern Developments in Open Hearth and other Steel Works Furnaces." Paper by A. V. Kemp.

JANUARY 23.

Institute of British Foundrymen (Wales and Monmouth Branch):—Meeting at Cardiff. "Metallography," Paper by F. Davidson.

Institute of British Foundrymen (East Midlands Branch):—Annual meeting at Loughborough.

JANUARY 26.

Sheffield Metallurgical Association:—Ordinary meeting at Sheffield. "Some Impressions of Continental Metallurgical Conditions," Paper by V. C. Faulkner.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Mass Effect and Cast Iron.

So far as we are aware, only one Paper has ever been presented on this subject in the English language, and that was a contribution by Mr. O. Smalley to the Paris Convention. There have been, however, many references to this subject by various prominent authorities from time to time. A striking example of the importance of this subject is given elsewhere in this issue by Mr. E. J. Fox and Mr. P. H. Wilson, in the Paper on "Spun Iron Pipe." In practically all their tests the 12-in. pipes show lower results than the 4 in. This has nothing in common with the production of the chill when spinning because, where cited, the figures for sand-cast pipe exhibit exactly the same phenomenon. The proposed I.B.F. standard tests for cast-iron take cognisance of this phenomenon by lowering the demands made upon thicker sections.

The "Perlit" system, of course, makes a definite attack upon the problem, and its advocates have demonstrated that up to a 5-in. section an even grain can be produced. But what about a 10-in. section? There must, of course, be a limit to the production of even-grain by this, or, in fact, any other process. If coring can be permitted, then possibilities for rapid chilling, both internally and externally, are present.

The following defects are to be associated with large mass effect (we use the word "large" because, inversely, very thin sections have their own special properties ascribable to the very fact that they are of small mass):—Coarse graphite structure, liquation and segregation, the possible exudation of phosphide eutectic at corners, the breakdown of cores, and growth on repeated heatings. The advantages to be associated with small mass are:—The ability easily to control the cooling conditions, the finer condition of graphite, the small lag between external and internal temperatures on heating and cooling practically eliminates growth on repeated heatings, as can easily be verified by examining some of the thin plates used in the construction of domestic fireplaces. All foundrymen have had some experience of the detrimental effect of "mass," and we strongly advise them to record both their difficulties and their methods of surmounting them, because it may happen that some person with a mania for protection of processes by patent applications may seek to cover what the foundryman has regarded as a normal foundry "gadget." It should be remembered that publication in any form whatsoever precludes the personal right to the exclusive use of the idea or process, but it also effectually prevents the "other fellow" from having a Patent on the subject worth the paper on which it is written. A founder, of course, may choose to protect some of the "gadgets" he is using, but because of the large number of foundries in the world, it is extremely likely that they have been simultaneously developed elsewhere.

The importance of the study of mass effect is such that we are of opinion that once a complete knowledge of the subject is available, the solution of the majority of foundry problems will be thereby exposed.

XUM

Institute of British Foundrymen.

LANCASHIRE BRANCH (JUNIOR SECTION).

Some Factors which Constitute Problems in the Iron Foundry.

Last Saturday a successful meeting, under the chairmanship of Mr. R. Stubbs, was held in the College of Technology, Manchester.

MR. S. G. SMITH, the lecturer, announced at the outset his intention of dealing with well-known facts in a new light, and of giving practical instances of these factors.

The importance of freezing phenomena was stressed. A cube, when cast, commenced freezing simultaneously from six sides. The crystallites grew normal to the cooling surface, and thus a cube contained natural planes of weakness at the intersection of the crystals. Under a compression test such a cube split up into six distinct pyramids which resulted from shear along the planes of intersection.

Volume changes were of great importance, and had claimed the attentions of workers like Turner, Keep, and West, whose results all led to the same conclusions. Solid contraction caused many foundry difficulties. There was no definite rule which could be applied in all cases. Chemical composition could largely control it. Mass effect was marked, heavy sections having less linear contraction than thin ones. As an example of this, a 40-in. two-flanged pipe body was cited. When the metal thickness was $2\frac{3}{4}$ in., a contraction of $\frac{1}{8}$ in. resulted on the 10-in. length, but when the thickness was only $\frac{1}{4}$ in., then the change in length was 1 in.

Distortion was a direct result of contraction; camber in long thin castings was a common example. Each type of casting demanded treating differently; a gutter or gap lathe bed were two extreme cases. The phenomena was due to the same cause in both cases, but the effect of mass, design, and composition of iron caused it to be shown in different ways. Experience alone could forecast what camber would occur in both cases.

Liquid shrinkage was inseparable from cast iron, and the cavities caused were not due to gas action. Examples of the effect of mass on shrinkage were illustrated by lantern slides. A wedge varying from six inches square to just an edge was held to be an ideal way of proving whether pearlitic iron could be produced with a uniform structure throughout such a mass. The lecturer asked what test bar or test bars could possibly represent such a casting.

The importance of correct sand control was well illustrated. Some double-flange castings had given continuous trouble due to liquid fracture. This was traced to sand which had too high a clay content, and had been overmilled, then subsequently rammed too hard. The sand was unyielding to the solid contraction which resulted, and produced fracture at the flange junction. A properly-milled sand with a correct bend, accompanied by suitable loose ramming, completely eliminated the defect. Another liquid fracture failure had occurred with risers on a heavy flywheel rim. In this instance a tapered feeding head had been literally wedged off by the top part core iron, and had resulted in an apparent draw under the feeder. Re-design of core iron and feeder peg completely overcame this.

The importance of adequate liquid metal in risers to accomplish proper feeding was illustrated in the case of a water-jacketed cylinder head. Chills in core and main mould did not eliminate the open places; but, after making a well-designed annular head an integral part of the pattern, the trouble, which had condemned seven castings on water test, disappeared.

Slight, but important, alterations in design often made what were formerly difficult castings into easily produced solid castings. Steam chests had given much trouble, more especially in the lighter castings, at junctions of varying sections. Usually there were five chambers which were subjected to individual water tests, and on occasion all leaked. The addition of ribs enabled feeding to proceed for twenty minutes at spots which formerly were inaccessible to new metal and the rod. The fact that the 12-cwt. casting gave more trouble than the 3-ton job of similar design merely emphasised the importance of heat distribution in mould and core. "Chubby" castings were always troublesome, due to the fact that with small sand bodies and relatively large metal masses, superheating of cores inevitably occurred, and this usually resulted in unsound castings.

The manner in which crystals grew in iron was dealt with by Mr. Primrose at the invitation of Mr. Smith. A 19-in. crystal of steel illustrated very clearly the manner in which primary crystallisation proceeds.

Discussion.

In opening the discussion, MR. SUTCLIFFE asked whether it was the practice of the lecturer to bare wheel bosses. Where the sand had been overmilled and hard-rammed, had there been any evidence of "blowing"? What was the colour of the fracture in those instances where so-called liquid fractures had occurred?

MR. R. STUBBS said that pearlitic cast iron had been mentioned; would the lecturer tell them a little more about that material?

MR. KEY, in giving a brief *résumé* on the subject of composition as related to pearlitic iron, wondered where we stood on that question. Lanz iron was supposed to contain a constant silicon plus total carbon figure of four; Thyssen Emmel claimed that a composition of 2.6 silicon combined with 2.6 total carbon was the best; yet another claim was now made that 3.3 silicon and 3.3 carbon gave the very best structure. This was, at the best, very misleading.

MR. PRIMROSE recalled a remark made by Mr. Smith some time ago, that "all iron was *more or less* pearlitic." True, pearlitic iron was really of maximum pearlitic constitution. That is, it contained neither free ferrite nor free cementite. This condition could only be obtained by controlling composition, and subsequently the rate of cooling. Where liquid fracture took place, one was really making the mould into a testing machine, and iron was notoriously weak at elevated temperatures.

MR. SMITH replied that with thin arms on wheels he would bare the boss. The particular casting depicted had arms 10 in. deep, and was not an ideal casting to bare. The main core could have been extracted. Design was the main factor in helping to obviate cracking. The designer now appreciated the fact that an increase in thickness often resulted in weakness. There had been no "scabbing" or blowing in the pipe castings, and that had rendered the tracking down of the fault more difficult.

Where the liquid fractures had taken place a deep blue colouration was always seen. Many years ago Dr. Stead had emphasised the fact that pearlitic cast iron was the best; and to-day it was to metal of that character we looked when high duty non-growth irons were needed. Foundry technique was still the controlling factor in the production of the perfect casting. Too much blame had hitherto been placed on the metal alone. There were many problems which had yet to be solved.

Foundry Query.

Liquid Iron Cement, Issue January 7.

Offers of help have been received from "E. S.," of Woodside, Lintzford Road, Rowlands Gill, Newcastle-on-Tyne, and Mr. J. A. Smeeton, of 15, Victoria Street, London, S.W.1.

Five-minute Paper Competition.

Next Saturday, at Loughborough, the East Midlands Branch of the Institute of British Foundrymen are holding a competition for the best five-minute paper on a foundry subject. The prize is to be a year's subscription to THE FOUNDRY TRADE JOURNAL.

MR. H. F. COGGAN, managing director of August Muffle Furnaces, hopes to return to business next week, after an illness which has kept him at home for the last eight weeks.

SIR HOLBERRY MENSFORTH, K.C.B., C.B.E., is resigning his post of Director-General of Factories in the War Office at the end of February to assume the managing directorship of Bolckow Vaughan & Company, Limited, of Middlesbrough.

The Principles of Centrifugal Casting as Applied to the Manufacture of "Spun" Iron Pipes.

By E. J. Fox and P. H. Wilson, respectively Managing Director and Foundry Manager of the Stanton Ironworks.

(*Continued from page 26.*)

Effects of Elements.

Silicon.—From the point of metal control this element is the most important. Silicon possesses the property of promoting graphitisation—it is easier to saturate a silicious iron with carbon than it is to saturate pure iron. By varying the silicon content it is possible to obtain an iron super-saturated, saturated, or under-saturated in respect to carbon. Control of the silicon content makes it possible—knowing the carbon content—to secure an almost eutectic melt, which for the process is ideal. Silicon tends to destroy chill, but if present

FIG. 13.—FRACTURE OF SPUN IRON, SHOWING CHILLED FACE.

in large quantity is prone to make the metal sluggish.

Manganese.

This element exerts its usual effects. It favours the production of chill, exerts a hardening influence and improves tensile strength. By combining with sulphur it causes the inward migration of the latter element. The manganese content, 0.3 per cent., in the metal used in the process under review is too low to cause much effect.

Phosphorus.

Tensile and bending strengths are improved by this element up to 0.8 per cent. P., and little detriment to mechanical properties occurs if 1.5

FIG. 14.—MICROSTRUCTURE OF CHILLED PORTION OF SPUN PIPE × 120 DIAS. ETCHED 10 PER CENT. NITRIC ACID.

per cent. P. is not exceeded. Above this amount the hardening and embrittling effects of phosphorus make themselves apparent. Phosphorus aids spinning by making the metal more fluid; by making the cooling range longer it tends to promote graphitisation. This can, however, be counteracted by the adjustment of the silicon content.

Sulphur.

This element is opposite to silicon in its effects. It favours production of chill and generally tends to close the grain of the metal. If present in any quantity it is most harmful.

Carbon.

The carbon content is fixed by the class of pig-iron in use. High carbon gives a sluggish metal quite unsuited to the process. Low carbon gives a free-running iron which has a decided tendency to chill. The requirement for the process is the correct adjustment of the silicon and carbon contents so as to secure a metal just saturated with carbon.

Production of the Chill.

A remarkable feature of the castings produced by this process is that the outer skin of the metal

FIG. 15.—MICROSTRUCTURE OF SPUN PIPE CAST IN HOT MOULD × 120 DIAS. ETCHED 10 PER CENT. NITRIC ACID.

is chilled (Fig. 13). Normally a cast iron of such a composition cannot be chilled by most severe quenching when cast in sections other than centrifugally, comparable with the thickness of a "spun" pipe. Three interesting simple experiments were performed to study the conditions producing this chill:—

(1) A pipe was centrifugally cast under normal conditions. The usual chill was produced. Fig. 14 shows the micro-structure of the extreme outer edge of the pipe. (2) A pipe was cast in a hot

FIG. 16.—MICROSTRUCTURE OF CHILL × 350 DIAS. ETCHED 10 PER CENT. NITRIC ACID.

mould, no cooling water being used. No chill was formed. Fig. 15 shows the micro-structure of this outer edge; and (3) Metal was poured into a stationary water-cooled mould. No chill was found.

These experiments show that water cooling and centrifugal action contribute to the formation of the chill. The mould, rotating in water which is constantly circulating, must possess a chilling surface capable of securing maximum cooling effects.

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The metal nearest to the mould face suffers the maximum quenching effect, and thus cools so rapidly that, in spite of its composition, it has no time to graphitise.

Microstructure.

Unannealed Castings.—The section of pipe reveals, on microscopical examination, three distinct fields:—(1) The outer chill; (2) the middle cellular structure; and (3) the inner fibrous structure.

The *chill* (Fig. 16) is definitely the well-known austenite-cementite eutectic along with primary

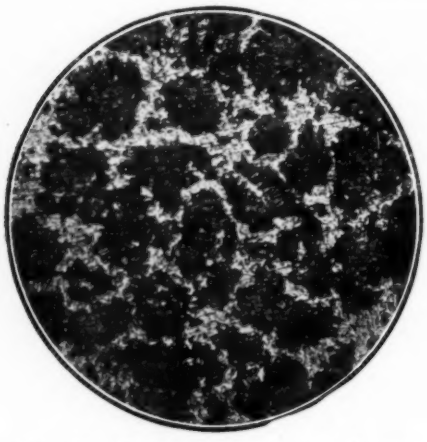


FIG. 17.—MICROGRAPH OF THE MIDDLE SECTION OF A SPUN PIPE × 100 DIAS. ETCHED 10 PER CENT. NITRIC ACID.

austenite, in the case of under-saturated metal; or with decomposed primary cementite in the case of super-saturated metal. The chill exists, as already explained, on account of the high rate of cooling secured in the process. The crystals of cementite and austenite are trapped in their original forms, having no time to decompose. The micrograph (Fig. 16) shows the nature of the chill, the crystals are elongated, having their

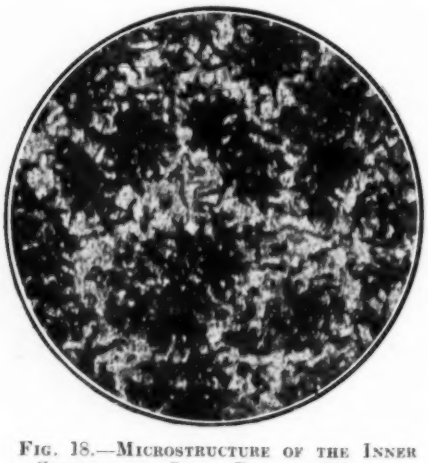


FIG. 18.—MICROSTRUCTURE OF THE INNER SECTION OF SPUN PIPE × 100 DIAS. ETCHED 10 PER CENT. NITRIC ACID.

orientation normal to the chilling face of the mould.

The *middle section* is cellular (Fig. 17). In this section the rate of cooling is less severe and decomposition of the original austenite and cementite has occurred. Graphitisation is almost complete, although the rate of cooling has been sufficiently high to cause the graphite to separate in an exceedingly fine form. Some martensite sorbite is occasionally present. The phosphide eutectic is shown to be distributed in a very fine form.

The *inner section* is of a coarser nature (Fig. 18); it is found in all but small pipes of thin section. This structure is representative of a still slower rate of cooling, the general field being graphite in a matrix of silico-ferrite. The graphite is noticeably coarser, being in the form of rosettes. Again the phosphide is in a finely distributed form.

Annealing or Normalising.

The chill on the outer skin of the pipe described is hard and must be destroyed. The austenite cementite being in an extremely unstable condition, readily responds to heat treatment. This heat treatment is a time-temperature process of the usual kind; the continuous furnaces used are arranged in respect to both time and temperature so as to enable the chill to be completely decomposed. The eutectic cementite graphitises, and the remainder of the structure decomposes to an approximately ferrite-graphite structure, some

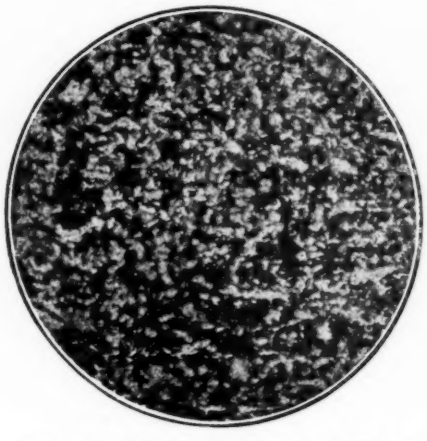


FIG. 19.—MICROSTRUCTURE OF ANNEALED SPUN PIPE × 120 DIAS. ETCHED 10 PER CENT. NITRIC ACID.

martensite-sorbite also being usually present. The micrograph (Fig. 19) shows the structure and emphasises its extremely fine nature.

It has frequently been suggested that the chill formed on this type of casting is harmful. It is agreed that chill itself is not desired, being hard and brittle, but when completely normalised it possesses extremely good mechanical properties, which do much to improve the quality of the pipe.

Annealing or normalising as practised does not affect to any extent the middle and inner sections of the pipes.

The enhanced properties of spun metal can be ascribed to the structural features obtained by the rate of cooling in conjunction with centrifugal

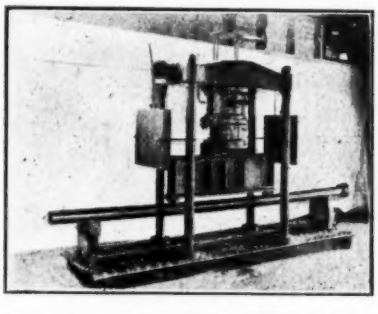


FIG. 20.—SPECIAL TRANSVERSE TESTING MACHINE FOR PIPES.

force, producing a fine deposition of the graphite, the fine distribution of the phosphorus, also a general reduction of grain size.

MECHANICAL TESTS.

The mechanical tests may be divided into two sections—"Tests on pipes as pipes" and "Tests on the metal as produced by the centrifugal process."

The tests in the first section were designed to determine the resistance of the pipe to such stresses as are likely to occur under working conditions, *e.g.*, internal pressure, external load and transverse strains due to incorrect laying or earth subsidence.

The tests in the second section include the deter-

mination of tensile strength, moduli of rupture, moduli of elasticity and hardness tests.

For these tests five different sizes of pipes were chosen, namely, 4, 6, 8, 10 and 12 in. dia. Some two hundred of these pipes were used for the investigation, and well over ten thousand observations were made. The average of all these tests will be given.

In order to obtain truly representative results the collecting of the sample pipes for test was spread over a period of fourteen months. As it

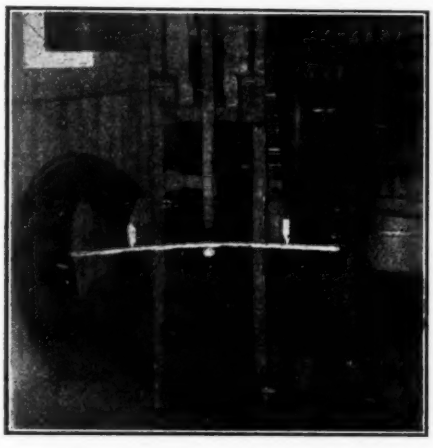


FIG. 21.—TRANSVERSE TESTING MACHINE FOR CUT SAMPLES.

was deemed advisable to compare the results from different experiments with certain factors constant, a system was devised to obtain this. The pipes were manufactured singly, in batches of three, and in batches of six, but in no case were two sets of the same size of pipe taken on the same day. The pipes received no special treatment, they were spun and annealed in the usual way, and the details of manufacture, temperature of metal, etc., were noted.

Hydraulic Pressure Tests on 12-foot Lengths.

The object of this test was primarily to determine the ultimate bursting pressure of pipes of varying size and thickness. The method of testing these pipes to destruction was as follows:—Suitable cast iron end plates, machined to form a joint capable of withstanding a high pressure, were held in position by external tie rods. The hydraulic pressure was applied by a high-pressure hand pump and the bursting pressures were read on a gauge with a tell-tale pointer. The gauge used was checked after each experiment against a standard gauge.

Before testing, each pipe was carefully measured, and after bursting the thickness was obtained by means of a micrometer at twelve places along the length of the pipe, the maximum, minimum and average being recorded.

Due to the high end-pressure necessary to make the joints in this test, it was evident that longitudinal stress was exerted on the pipes by tightening the bolts. The test was, therefore, repeated on short sections 5 ft. in length cut from different portions of the pipe.

The object of this test was threefold:—(1) To ascertain if any one sectional length of the pipe was stronger than the other; (2) to find the errors due to the possible bending of the longer length of pipe; and (3) to compare the bursting pressures with results from other experiments carried out on sample bar cut from the pipes.

The tensile figures obtained from the bursting pressures can only be looked upon as relative.

The formula used for calculating these is:—

$$ft = \left(\frac{(R_1^2) + (R_2^2)}{(R_1^2) - (R_2^2)} \right) p.$$

ft = tensile strength in lbs. per square inch.
R_1 = outside radius of the pipes in inches.
R_2 = inside radius of the pipes in inches.
p = hydraulic pressure in lbs. per square inch.

The figures shown in Table I give the average results obtained.

TABLE I.—*Tensile Figures Obtained from Bursting Tests.*

Dia. of pipe in ins.	Bursting pressure. Lbs. per square in. Average thickness in ins.	12 ft. length.	Average thickness in ins.	5 ft. length.	Calculated tensile strength. Tons per sq. in. 12 ft. length.	5 ft. length.
6	0.367	2,800	0.351	3,200	12.75	14.51
8	0.354	2,500	0.398	2,850	13.30	14.41
10	0.427	2,250	0.444	2,650	13.58	14.45
12	0.442	2,000	0.448	2,300	13.46	14.65

No results are available for the 4-in. pipes as the bursting pressure of these are higher than that obtainable by the pump and tackle used, viz., 6,500 lbs. per sq. in.

For comparison with the above there is given in Table II the figures obtained from similar tests on 5-ft. lengths of sand cast pipes.

TABLE II.—*Tensile Strength of Sand Cast Pipes calculated from Bursting Pressures.*

Dia. of pipe in ins.	Thickness in ins.	Bursting pressure. Lbs. per sq. in.	Calculated tensile strength. Tons per sq. in.
6	0.424	2,050	6.94
8	0.481	2,200	8.87
10	0.507	2,050	9.58
12	0.545	1,550	8.04

The figures for the short lengths are consistently higher than those for the full length pipes, this being due to the greater bending effect on the longer pipes due to end pressure exerted by the bolts.

From the above figures it will be seen the strength of the spun pipes was on an average 74 per cent. above that of the sand cast. The average calculated tensile strength was 14.5 tons per sq. in. for "spun" pipes 5 ft. long, compared with 8.36 tons per sq. in. for sand cast pipes. These figures appear low, but it will be proved later by other tests that this is due to combined stresses set up in the pipes by this method of testing.

External Pressure Test (Line Load).

In order to obtain a measure of the resistance of the pipes to external loads, such as heavy vehicular traffic and trench filling, this test was made.

The press used consisted of four hydraulic cylinders suspended from a cross-piece forming part of a substantial frame. Sections 24 in. and 12 in. in length cut from different portions of each of the pipes were tested in this machine. Before being tested the external diameter of the sample was measured at four different places to the accuracy of 1/100 of an inch. After the test the thickness was measured with a micrometer at six points along the fracture and the average noted.

The modulus of rupture was calculated from the formula:—

$$\text{Modulus of rupture} = \frac{6}{2\pi} \times \frac{(W (D_1 - t)}{bt^2}$$

where W = weight applied in lbs.
t = thickness of pipe in inches.
b = length in inches.

The point of the first fracture was observed, which occurred at the top or at the bottom of the pipe, these being the points at which the maximum stress takes place.

The average results are given in Table III:—

TABLE III.—*Modulus of Rupture of Spun Pipes calculated from External Pressure Tests.*

Dia. of pipe in ins.	Thickness in ins.	Load per foot in tons.	Modulus of rupture.
4	0.383	8.56	60,060
6	0.379	6.72	54,767
8	0.394	5.47	53,595
10	0.442	5.78	55,257
12	0.441	4.46	52,081

Transverse Test on Pipes.

Pipes when laid in the ground or when supported on beams are subjected to bending stresses, and this test was designed to determine the strength of the pipes under such conditions. A machine (Fig. 20) was designed consisting mainly of a heavy bed plate to which was attached a hydraulic ram as shown. The pipe to be tested was supported on the bed-plate on two supports 10 ft. apart. The supports were of cast iron and shaped to fit one-quarter of the circumference of the pipe, and the bearing surface was 1-in. broad.

The load was applied at two points, 4 ft. apart, symmetrical with the end supports. The packing pieces were similar in shape to the supports. The pressure in the cylinder was read on a set of gauges. The area of the cylinder was exactly 112 sq. in., and consequently 1 lb. in the gauge represented a load of 1 cwt. on the pipe. The deflections were measured to an accuracy of 1-1,000 of an inch by means of a vernier depth gauge on a tail rod, which was fixed to the ram.

As before, the pipe to be tested was first carefully measured. The amount of the deflection was noted under five different loads. After this the load was increased steadily up to the breaking point, and gauge readings were recorded. The thickness was then measured at the fracture with a micrometer.

It was deemed preferable to apply the load at two points rather than one, because, by this means, the maximum strain was put on a fairly long length of pipe instead of at only one point. Also, in this way, the deformation of the pipe in its cross-sectional plane was reduced, with a consequent reduction of error.

Under the conditions of this experiment the deflections were measured at the point of application of the load, and therefore the maximum deflection at the centre had to be calculated.

The modulus of elasticity was calculated from the formula $\frac{Wa^2}{12\ EI}(3l-4a)$ = deflection at point of application of load.

Where W = load; a = one-half the difference between the distance between the points of application and the distance between the supports; E = modulus of elasticity; I = moment of inertia; l = distance between supports.

The value of I being determined from:—

$$I=\frac{\pi}{64}(D_1^4-D_2^4)$$

The deflection used for the calculation of E was that which was measured when the pipe carried a weight equal to about 25 per cent. of its breaking load.

The modulus of rupture was calculated from the formula.

$$\text{Modulus of rupture}=\frac{M}{Z}\text{ where }M=\frac{Wa}{2}\text{ and}$$

$$Z=\pi\times\frac{(D_1^4)-(D_2^4)}{32D_1}$$

$$\therefore\text{ Modulus of rupture}=\frac{Wa}{2}\times\frac{32D_1}{\pi(D_1^4)-(D_2^4)}$$

with a = 36 ins., modulus of rupture $=\frac{183.5\ WD_1}{D_1^4-D_2^4}$

Although the bed-plate was designed to be as rigid as possible, it was obvious that there would be some slight movement. The machine was, therefore, calibrated, and the results were corrected accordingly. Table IV gives the average result of this test:—

Transverse Test on Sample Bars.

The following tests were made from pieces cut from the sample pipes to enable a comparison to be made with spun metal and the figures usually specified for ordinary cast iron. The bars were cut longitudinally from different portions of the pipe. There were two bars cut from each portion, one being 1 in. broad and the other ½ in., whilst the thickness was that of the pipe.

The tests were carried out on the machine shown in Fig. 21. The load was applied at a point central between the knife-edged supports, which were 12 in. apart. The bars were loaded with regular increments, a hundred lbs. for the 1-in. bars and 50 lbs. for the ½-in. bar up to the breaking point, and the deflections were measured. These measurements were taken by means of a vernier.

The moduli of rupture and elasticity were calculated from the usual formula.

$$\text{Modulus of rupture}=\frac{M}{Z}\text{ where }M=\frac{Wl}{4}$$

$$\text{and }Z=\frac{bt^2}{6}$$

$$\therefore\text{ Modulus of rupture}=\frac{3Wl}{2bt^3}$$

$$\text{Modulus of elasticity}=\frac{Wl^3}{48\ I\times\text{deflection.}}$$

$$\text{Where }I=\frac{bt^3}{12}$$

$$E=\frac{Wl^3}{48\ defl.}\times\frac{12}{bt^3}=\frac{Wl^3}{4bt^3\ defl.}$$

Both these formulæ assume that the section of the bar is rectangular, but as these were cut out of a pipe, this is not the case, two sides being curved. Due to the shape of the section, the modulus of the figure is evidently something slightly bigger than $\frac{bt^2}{6}$, and a corrective factor has to be introduced.

Using the following notations:—

Where b = breadth in inches.
t = thickness in inches.
R_1 = outer radius } of the pipe from
R_2 = inner radius } which the bar has been cut.

the following corrective factor for t was devised:—

$$1+\frac{b^2}{10R_1\ R_2}$$

This factor is approximate, but the error is only in the third decimal place, and is therefore negligible, and no greater than the possible errors of observation.

From the figures in Table V it will be seen that the average results for "Spun" metal and sand cast are as follows:—

	Spun.	Sand cast.
Average modulus of rupture	59,768	45,025
Average modulus of elasticity	15,870,086	13,910,000

The figure specified for the British standard transverse bar 2 in. × 1 in. tested on 3-ft. supports, is 28 cwts., with a deflection of 0.33 ins.

TABLE IV.—*Transverse Test Results on Spun and Sand Cast Pipes.*

Dia. of pipe in ins.	Thickness. Inches.	Breaking load. Lbs.	Maximum deflection at centre in ins.	Modulus of rupture.	Modulus of elasticity.
SPUN.					
4	0.320	14,900	2.11	53,000	17,350,000
6	0.391	31,400	1.13	45,600	16,850,000
8	0.381	50,400	0.80	41,000	16,910,000
10	0.373	77,300	0.82	41,400	12,700,000
12	0.437	103,000	0.64	34,950	11,290,000
SAND CAST.					
4	0.432	7,560	1.20	23,200	11,400,000
6	0.454	21,000	0.97	27,200	11,930,000
8	0.513	33,600	0.62	21,600	11,150,000
10	0.615	76,100	0.64	26,600	10,650,000
12	0.603	100,800	0.55	25,600	9,560,000

The figures in Table V give the average result of all the bars tested:—

TABLE V.—*Transverse Tests of Bars Cut from both Spun and Sand Cast Pipes.*

Dia. of pipe in ins.	Width of bar in ins.	SPUN.		SAND CAST.	
		Modulus of rupture.	Modulus of elasticity.	Modulus of rupture.	Modulus of elasticity.
4	1	71,767	16,050,000	40,500	—
	½	68,422	15,295,000	43,400	—
6	1	64,500	15,870,000	52,700	13,470,000
	½	63,610	15,990,000	49,200	—
8	1	64,300	16,750,000	41,200	13,000,000
	½	62,300	16,450,000	44,800	—
10	1	58,400	16,000,000	46,000	14,270,000
	½	59,400	15,550,000	44,850	—
12	1	59,000	15,850,000	42,300	14,900,000
	½	58,000	15,100,000	45,300	—

The figures in Table VI show the equivalent breaking load on a standard 2-in. x 1-in. bar calculated from the above results:—

TABLE VI.—*Equivalent Breaking Loads on Standard Bar calculated from Table V.*

Dia. of pipe in ins.	Width of bar in ins.	Calculated breaking load. 2″ × 1″ bar × 3′ 0″ support.	
		Spun.	Sand cast.
		Cwts.	Cwts.
4	1	47.46	26.8
	½	45.25	28.7
6	1	42.66	31.85
	½	42.07	31.54
8	1	42.77	27.25
	½	41.32	29.63
10	1	37.82	30.42
	½	39.23	29.66
12	1	38.05	27.98
	½	38.29	29.96

Tensile Tests.

Tensile test pieces were cut from all pipes on which experiments were made. In those cases in which the whole pipe was used for other tests, the pieces were cut from broken fragments, otherwise they were cut from the spare pieces. In every case two pieces were cut from the same longitudinal section of the pipe and the average result used. The average results of 170 tests are given in Table VII:—

TABLE VII.—*Tensile Tests of Pieces Cut from Pipes.*

Dia. of pipe in ins.	Tensile strength.	
	Spun.	Sand cast.
4	19.98	10.58
6	19.10	10.71
8	18.43	11.00
10	18.05	11.65
12	18.00	10.90
Average	18.71	10.37

The British Standard Specification for cast-iron pipes calls for a tensile test of 9½ tons per sq. in.

Ring Tests.

Since the physical properties of spun iron are so widely different from those of the same iron cast in sand moulds, in order to test the strength of the metal in spun iron pipes it is obviously useless to cast transverse and tensile test bars in the ordinary way. To cut them out of pipes is an expensive operation, so it was suggested that rings should be cut from the pipe and tested in a similar way to that of the link of a chain.

This method of testing the strength of the spun iron has been adopted by the Stanton Company, and is much appreciated by engineers by virtue of the fact that the result obtained from the test ring represents the strength of the metal as it exists in the finished pipe. A large number of experiments were made, in which the rings were tested and compared with tensile tests pieces cut from an adjacent portion of the pipe, and it was found that the following formula is approximately correct:—

$$f = \frac{W\ (D-t)}{4{,}000\ bt^2}$$

Where W = breaking load in lbs.; D = outer diameter of ring in inches; b = breadth of ring, and t = thickness.

This formula may be deduced theoretically as follows:—It is commonly known that if a cast-iron bar is broken transversely and the maximum skin tension calculated, this maximum will be about 1.72 times the tensile strength of the iron in direct tension. In breaking a ring the bending moment is $\frac{W\ (D-t)}{2}$ and the resisting moment is $\frac{bt^2}{6}$, ∴ the maximum skin tension in lbs. per square inch is $\frac{6\ W\ (D-t)}{2\ \pi\ bt^2}$

This will be equivalent to a direct tensile strength of $\frac{6\ W\ (D-t)}{2\ \pi\ bt^2 \times 2{,}240 \times 1.72}$ in tons per square inch, *i.e.* $\frac{W\ (D-t)}{4{,}034\ bt^2}$ which agrees very nearly with the above formula.

The average results of the series of tests under consideration are given in Table VIII, also the results obtained from a similar number of rings cut from sand-cast pipes for comparison.

TABLE VIII.—*Ring Tests on Spun and Sand Cast Pipes.*

Dia. of pipe in ins.	Modulus of rupture.		Calculated tensile strength in tons per sq. in.	
	Spun.	Sand cast.	Spun.	Sand cast
4	79.280	47.800	20.75	10.8
6	72.113	46.200	18.89	11.09
8	71.300	47.650	18.68	11.1
10	67.800	47.200	18.2	10.64
12	65.600	46.650	17.8	10.58

From this test the average modulus of elasticity of the spun pipe calculated from the increase of vertical diameter = 15,877,000.

Brinell Hardness Tests.

Small pieces were taken from every broken pipe and also each ring used on this test, and were tested on a Brinell hardness machine, using a ball 10 mm. dia. and pressure 1,000 kilo. for 15 secs. Readings were taken from the outside of the pipe, the inside, and the middle of the fracture. The average hardness number of approximately 2,000 results is 182.

Conclusion.

In conclusion, it is the opinion of the authors that in the course of time the methods of casting iron described in this Paper will take the place of the more usual methods which have been the practice in the past.

In expressing this opinion, the writers do not overlook the fact that the Stanton Company, who are certainly by far the largest pipe makers in Europe, and probably in the world, will be the greatest sufferers, in consequence of having to discard plant, patterns, jigs, etc., on a scale obviously in excess of what would be necessary in the case

of an undertaking with a smaller capacity of plant.

The characteristics of the spun iron are so outstanding that it can only be a question of time before the process replaces older methods.

From a commercial point of view perhaps the greatest disadvantage to the universal adoption of the centrifugal method of making iron pipes is the fact that unless the pipes are made on an extensive scale, and unless manufacturing operations are continuous, namely day and night, the full advantage is not being taken of low manufacturing costs; and it follows from this that the process will only be adopted by those concerns, and in those countries where an extensive demand is assured. In plain language, the advantages of the spun pipe can be summarised under the following headings:—

(1) The resulting pipes are stronger, and can consequently be made thinner than the ordinary sand cast pipes. The latter are purposely made thicker than the actual requirements demand, to allow for irregularities in moulding and possibilities of flaws in the metal.

(2) The resulting pipes can be relied upon as being uniform one with the other, independent of the skill of the manual labour employed. The necessity in the case of the process of making spun pipes lies in the direction of maintaining the machinery in good condition, and does not rely to the same extent upon labour. It will be agreed that of the two it is easier to maintain machinery at concert pitch than it is to rely upon the more varying factors associated with every-day labour.

(3) The fact cannot be overlooked that the ordinary methods of making iron pipe necessitate employment of labour under conditions far from congenial, and there is no disguising the fact that during recent years there has been a difficulty in getting apprentices to follow in the footsteps of their fathers. Not unnaturally, the youth of the coming generation drops into work where the surroundings and working conditions are as amenable as possible. It follows from this, therefore, that a process which largely dispenses with the disagreeable conditions of ordinary pipe making, must have its advantages.

(4) Last, and not least, the process is one which cannot fail to produce pipes more cheaply than present methods.

Finally, it is always difficult to introduce anything new into so conservative a country as England. The fact, therefore, that up to the end of November, 1925, over 1,673 miles of these pipes have already been made and supplied must be looked upon as satisfactory, and that of these 1,673 miles of pipes, 73 per cent. represent repeat orders placed by those who have given the pipe trial, speaks for itself.

The plant laid down at Stanton for making these pipes is turning out some 25 miles per week, in sizes varying from 4 up to 15 in. dia.

There is no reason to believe that pipes of larger diameter could not be equally well made by this process, but the demand for the larger sizes of pipe is a good deal more erratic, and it is doubtful whether a plant would be justified unless it was kept in fairly continuous operation. This it would be difficult to do when making sizes over and above the ordinary "bread and butter" sizes.

MR. F. DUDLEY DOCKER has been re-elected president of the Midland branch of the National Union of Manufacturers. MR. E. L. PAYTON and Mr. P. J. Hannon have been chosen vice-presidents.

IN ACCEPTING an offer by the Stanton Ironworks Company, Limited, near Nottingham, to supply pipes to the value of £62,000, the Londonderry Corporation declined to consider foreign tenders.

THE COMMITTEE OF MANAGEMENT of the London Iron and Steel Exchange have arranged for the annual dinner to take place at the Trocadero Restaurant, Piccadilly, W.1, on Tuesday, February 9. Special interest attaches to this year's function, as Sir William Pryke, the Lord Mayor of London, has accepted an invitation to attend the dinner, accompanied by the Sheriffs. Mr. R. T. Ellin, the Master Cutler of Sheffield, and many other prominent gentlemen associated with the iron and steel trades have also accepted invitations. It is many years since there was a Lord Mayor so closely associated with the iron and steel trades as Sir William Pryke.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

The Birth of the Electric Furnace Industry.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—In your issue of January 7, you print the discussion on a Paper by Mr. Melmoth, and in some remarks by Mr. J. G. S. Primrose, the following statement is made:—

"It was an interesting historical fact, which not many people knew, that Messrs. Lake and Elliott, of Braintree, was the first firm in this country at whose works the electric furnace was used commercially for producing steel. Sheffield might have a claim to priority in respect to experimental work in that direction, but actual commercial production began at Braintree."

This statement is not correct, inasmuch as Messrs. Edgar Allen and Company, Limited, was the first in the country to make electric steel commercially by the arc process. Our Heroult furnace was started on March 3, 1910, and was in operation for nearly a year before Messrs. Vickers Limited made their first heat, which was about February 9, 1911. Messrs. Lake and Elliott made their first heat on February 20, 1911, and Messrs. Thos. Firth on February 14, 1911.

We shall be glad if you will kindly draw your readers' attention to this necessary correction.—Yours etc.,

FOR EDGAR ALLEN & COMPANY, LIMITED,
E. N. S.

Imperial Steel Works, Sheffield.
January 15, 1926.

[We are pleased this subject has been raised because we were under the impression that for the first few years of its installation, the Heroult furnace at Edgar Allen's works was engaged upon the manufacture of tool steel, which would make the Lake and Elliott plant the first to manufacture commercially *steel castings*. Another interesting fact is that the second, third and fourth arc furnaces were started up in Sheffield during the same week, the one not mentioned in the above letter was an Electric Metals furnace at the Stobie Steel Company's works at Warren Street, Sheffield. This furnace was hand-tilted and used square-sectioned electrodes. We should welcome another letter from Edgar Allen's, clearing up the point as to whether they were actually engaged upon the manufacture of castings before the advent of the Lake and Elliott furnace. Other points of interest which it would be interesting to establish are: (1) The largest electric steel melting furnace in Great Britain (this is probably the Armstrong Whitworth Plant): (2) who made the first cast of high-speed steel: (3) which was the first Greaves-Etchell installation: (4) who made the first cast of stainless steel; (5) which was the first Stassano type furnace; (6) which was the first large furnace (say 10 tons capacity); (7) other historical data. —EDITOR, *F.T.J.*]

Publications Received.

The Iron and Steel Trades in 1925.—William Jacks & Company, Winchester House, Old Broad Street, London, E.C.2.

This 24-page pamphlet reviews trade conditions for the iron and steel industries for 1925. After a general review, the following sections of the industry are separately dealt with:—Cleveland Pig-iron Trade; Pig-iron Production; Prices of Cleveland Iron; Hematite Iron Ore; Manufactured Iron and Steel; Manufactured Iron and Steel Prices; Wages and Shipbuilding.

Trade Marks. By Benj. T. King.—King's Patent Agency, Limited, 146A, Queen Victoria Street, London, E.C.4.

This interesting pamphlet is mainly made up of extracts of a paper which Mr. King read before the Publicity Club of London. There is included a particularly good list of suggested trade marks.

Making a 60-Ton Fly Wheel.

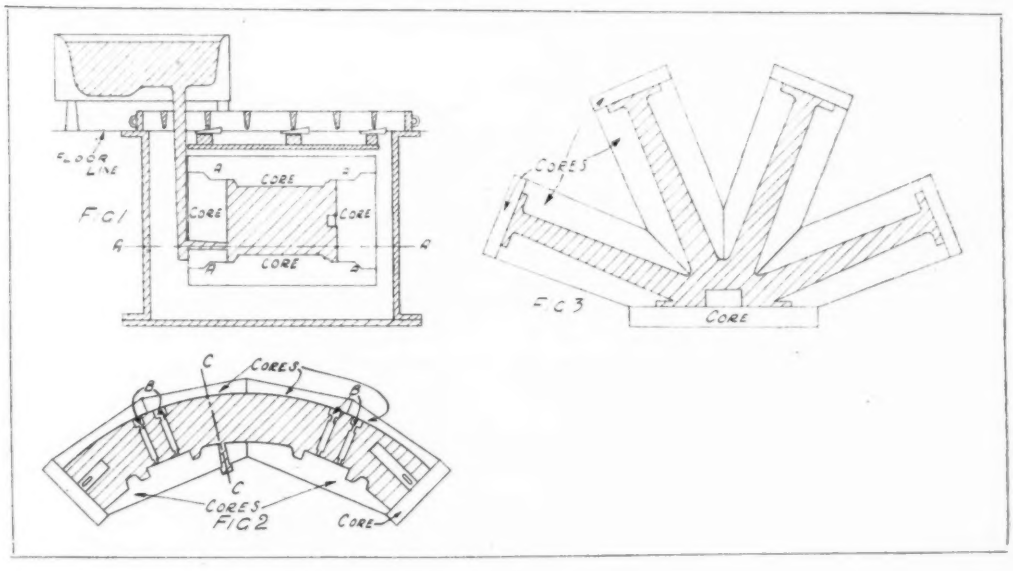
By J. E. P.

This wheel was made in six sections with strong sand cores only. The reason why this wheel was cast in sections was chiefly to facilitate transport, as it had to travel about 200 miles from the makers to its destination; to reduce the risk in making; to make it more convenient to handle all parts of the mould, and to reduce the work on it in the pattern shop.

Only one core-box for the outer part of rim, one for the inner part, one for the ends, one for the top and bottom, one for the bolt holes, one for the dowel holes, one for the key holes and one for the teeth cores, were required.

These eight core-boxes made all the 80 cores for the rim. That is 20 cores for each section. Of course, this wheel could have been struck up in loam, but this would have entailed making heavy special tackle, something like 25 tons for one section, and then it would have been extremely cumbersome and would ultimately have cost more.

The method adopted will most readily be seen and the better understood by refering to Figs. 1, 2 and 3, which show the section plan of the rim and the plan of the arms, with cores at the top, bottom, sides and ends.



The rim was made in four sections, while the boss or hub, with arms, was made in two. Each section weighed a little over 10 tons.

The number of cores required for the rim section was as follows:—Four for the bottom, four for the top, four for the outside diameter, two for the inside diameter, two for the ends, two for the dowel-pin holes, two for the key holes, eight chambered cores for the bolt holes and 30 for the teeth round the centre of the outside diameter, for starting purposes.

All core-boxes were made open at top, sides, or ends, and strickles were used to give the shape where necessary. All core irons were made very strong, not only to carry the cores, but also to withstand the great pressure of liquid metal at the time of pouring.

The coresand used was of a strong nature, in the proportion of four parts of good red sand (new), one of floor sand (old) and one of finely chopped horse manure, all thoroughly mixed and milled.

When all the cores were made, they were finished off smoothly on the face and blacked with a coating of heavy carbon blacking, then a thin coating of good machine oil on top of the wet blacking. This oil, when properly applied on a good blacking, will impart a beautiful blue skin to the casting.

When all the cores were definitely dry, they were carefully inspected and assembled readily for fitting together in the casting pit, in which a firm strong bed of sand was levelled by the use of straight edges.

The four bottom cores were then placed upon this bed in their correct positions, fixed and secured.

The steps (A, Fig 1) provide a sure guide for all the cores to be correctly located. After these cores had been placed in their several positions on the bottom, and carefully checked by the drawing, they were packed with iron plates and bars to the sides and ends of the pit plates, then rammed up soundly to the joint line.

The bolt cores (B, Fig. 2) were sheathed with cast iron barrels to prevent the great heat of the liquid metal fusing the sand of the cores. These bolt cores were held in position by means of cast iron block chaplets, which were made specially for the purpose, and answered admirably in holding the bolt cores from floating. Smaller cast-iron chaplet blocks were also used to hold the dowel-pin cores in their position.

The side and end cores having been rammed up to the joint line, the vents were all connected, and the runner, down stick and gates built and backed up by a cast-iron runner box made for this class of work, to prevent the molten metal getting away.

The top cores were readily placed upon the other cores and truly located by the aid of the steps (A, Fig. 1). Then a layer of sifted floor sand was strickled on them, about 1 in. thick. On top of this sand, strong cast-iron plates were placed and rubbed home.

A large top-part of a moulding box was then lowered on to the edges of the pit plates. Wrought-iron wedges were then fixed at intervals between the pit plates and the top box to ensure the box taking a proper bearing all round. Then the plates on top of the cores were wedged carefully to the under part of the stays of the moulding box. This top box was then rammed up, the runners, risers and vents being properly attended to in the usual manner.

One weight of 20 tons and two of 15 tons each, were used to weight down the whole, the mould having been built sufficiently strong, so that there was no danger of this 50 tons weight crushing it. On the other hand this weight would and did ensure all parts of the mould being held securely in their positions and so preventing the mould bursting.

The riser was placed near the centre of the section, with large head cup or basin, capable of holding about 5 cwt. of metal for feeding, i.e., to supply hot liquid metal into the mould to take up the liquid contraction which was going on during solidification.

This feeding process occupied two and a half hours, and was achieved in relays, each man

taking a fifteen minutes turn. Hot metal was poured into the riser at intervals.

The runner cup or basin was made of loam, and large enough to hold about two tons of metal. The bottom of this runner cup, just where the stream of metal would pitch or drop from the ladle when pouring was slightly lower than the main bottom, thus forming a well, which when filled would allow a very clean pour without splashing. The whole of the 12½ tons of metal could then be poured into the mould without anyone getting excited or burned by splashes.

The boss or hub, with arms, was cast in two sections, each having four arms and half the hub, and each section weighed a little over 10 tons. Eleven cores were required for each section, four for the arms, four for the face of the flanges at the end of the arms, one for the face of the hub, and two for the top and bottom of hub.

The arm pattern, which runs through the centre of the core-box, was jointed at each end, to allow its being drawn from the core. A centre line was then scribed at each end of the core, and a corresponding line marked upon the foundation bed, so that the correct setting of the cores was ensured. Weights were then placed upon the cores to hold them in position while the ramming up proceeded.

The placing of hub face-core was a simple matter, as the half-square core had only to be centred. When all were securely fixed and rammed up, sand and plates were put on the top and a moulding-box rammed up as in the case of the rim section. Two runners were placed on the half of the hub, and a small riser was placed on the flanges at the end of the arms. The feeding was accomplished through the runners. Altogether it was a very successful job, incurring the minimum expense in all directions.

The Detroit Congress.

The International Foundrymen's Congress, which is being organised under the auspices of the American Foundrymen's Association, promises to be an outstanding event in the history of foundry technology. What the hosts term "plant visitations" are being organised on a very extensive scale. The details of these can be had on application to the European delegate of the Foreign Relationship Committee of the American Foundrymen's Association, Mr. V. Delport, 2 and 3, Caxton House, Westminster. Below we give the preliminary programme of the trip:—

Preliminary Programme.

Travel agency's couriers will handle all travelling arrangements, baggage, hotels, etc.; whilst the entertainment features will be handled by A.F.A. organisation and local foundrymen.

SATURDAY, SEPTEMBER 11. — Leave European Channel port.

MONDAY, SEPTEMBER 20.—Arrival in New York. Transfer of guests to official hotel in New York, where an informal reception will be held if time of day permits. No other arrangements on first day.

TUESDAY, SEPTEMBER 21.—Dinner of welcome in New York.

WEDNESDAY, SEPTEMBER 22.—Leave on 8.00 a.m. train for Philadelphia: breakfast en route. Visit Philadelphia foundries and Sesqui-Centennial exposition. Dinner and welcome by Philadelphia foundrymen in the evening.

THURSDAY, SEPTEMBER 23.—Visit plants at Philadelphia.

FRIDAY, SEPTEMBER 24.—Leave for Buffalo from Philadelphia in morning in special parlour cars on some regular train. Spend night in hotel at Buffalo. Lunch included on train.

SATURDAY, SEPTEMBER 25.—Visit plants at Buffalo: reception by Buffalo foundrymen.

SUNDAY, SEPTEMBER 26.—Visit Niagara Falls, Canadian Falls, the Whirlpool, the Rapids, etc. This trip takes an entire day, returning to Buffalo. Leave on evening boat for Detroit. Stateroom berth and evening dinner on steamer included.

MONDAY, SEPTEMBER 27.—Arrive Detroit Monday a.m.; reception by local committee—official visit and welcome to exhibition and International Convention. Breakfast on steamer included.

TUESDAY, SEPTEMBER 28.—Attend Convention.

WEDNESDAY, SEPTEMBER 29.—Attend Convention.

THURSDAY, SEPTEMBER 30.—Attend Convention. A.F.A. at the annual banquet.

FRIDAY, OCTOBER 1.—Attend Convention—final resolutions.

SATURDAY, OCTOBER 2.—Post-Convention Party.

Tentative Technical Programme.

MONDAY, SEPTEMBER 27.—Morning: (1) Opening meeting; address of welcome; responses. Afternoon: (2) Non-ferrous-brass topics; (3) steel-shop practice.

TUESDAY, SEPTEMBER 28.—Morning: (4) Steel metallurgy; (5) non-ferrous - aluminium and aluminium alloys; (6) symposium—permanent and long-life mould castings. Afternoon: (7) Apprentice training; Institute of Metals Division, A.I.M.E.; A.F.A. Committee meetings.

WEDNESDAY, SEPTEMBER 29.—Morning: (8) Foundry costs; A.F.A. Committee meetings. Afternoon: (9) Management (personnel administration); (10) report of General Committees and General Papers.

THURSDAY, SEPTEMBER 30.—Morning: (11) Sand control; (12) cast iron. Afternoon: Business meeting; (13) refractories.

FRIDAY, OCTOBER 1.—Morning: (14) Cast iron; (15) malleable cast iron. Afternoon: (16) Sand control.

Post-Convention Tour (Optional).

SUNDAY, OCTOBER 3.—No arrangements. Leave by evening train for Chicago. Pullman berth included.

MONDAY, OCTOBER 4.—Arrive Chicago in the morning. Transfer to hotel. Reception by Chicago foundrymen. Dinner in evening.

TUESDAY, OCTOBER 5.—Visit to plants in Chicago. Night train to Cleveland. Pullman berth included.

WEDNESDAY, OCTOBER 6.—Arrive Cleveland in the morning. Transfer to hotel. Visits to plants. Official dinner in the evening by Ohio foundrymen.

THURSDAY, OCTOBER 7.—In Cleveland. Take late afternoon train to Pittsburgh. Parlour car seat and evening dinner on train included. Arrive Pittsburgh in the late afternoon. Transfer to hotel.

FRIDAY, OCTOBER 8.—In Pittsburgh. Official dinner by Pittsburgh Foundrymen's Association.

SATURDAY, OCTOBER 9.—Visit to plants in Pittsburgh.

SUNDAY, OCTOBER 10.—Daylight trip to Washington, D.C. Lunch on train included. Transfer to hotel.

MONDAY, OCTOBER 11.—In Washington. A comprehensive sight-seeing trip will be provided, taking in the City of Washington and Arlington National Cemetery. In the afternoon a boat trip will be provided to Mt. Vernon, the home of Washington.

TUESDAY, OCTOBER 12.—At New York.

WEDNESDAY, OCTOBER 13.—Official party sails for Europe.

THURSDAY, OCTOBER 21.—Arrive at European port.

THE ERECTION of an up-to-date generating station, at a cost of £141,346, is contemplated by the Middlesbrough Corporation. For a considerable time the electricity supplied to the town has been secured from the Cleveland and Durham Electricity Company, although the Corporation has possessed a small generating plant. The new scheme is the outcome of the submitting of revised terms for the supply to the Corporation of electricity in bulk by the company.

THE ARMCO INTERNATIONAL CORPORATION announce that "Armco" ingot iron is now being manufactured on a very large scale in this country, and associated with them in their enterprise are such firms as the Shelton Iron Steel & Coal Company, Limited, Guest, Keen & Nettlefolds, Limited, the Scottish Iron & Steel Company, Limited, the Whitecross Company, Limited, the Wolverhampton Corrugated Iron Company, Limited, the Scottish Tube Company, Limited, and Guest, Keen & Piggotts, Limited.

Discussion on Major Appleyard's Paper on "The Training and General Position of the Craftsman."*

The BRANCH-PRESIDENT, Mr. M. B. Herbst, said he noticed that Major Appleyard had very high ideals for the social life of the foundryman, and he was in total agreement with his ideas as to having places for the men where they could sit comfortably and discuss their various problems.

MR. V. STOBIE thought that Major Appleyard had given a very important Paper. He admitted that certain of the views expressed by the lecturer appeared, perhaps, a little idealistic, but the majority of them were very practical solutions to important problems of the day.

The way to get a man interested in his task was to show him the ultimate result of that work. For instance, when a man has to make castings for a printing machine, let him not only see the actual machine but also the output from the press in which his castings are used. In other words, let him see that he is really producing something which is going to be of universal use.

With regard to the question of machinery disposing with the necessity for skilled men, he thought that this statement should be modified a little, perhaps, because instead of doing away with the skilled man it provided an opening for the highly-skilled. The only men the machine displaced were those who had only a little skill, and they would either have to try to attain greater skill or else become ordinary moulders.

Factory System and Standard of Living.

MR. W. J. PAULIN said he noticed that the lecturer pointed out that certain men after a while departed, as it were, into one sphere of activity for which they were eminently suited. He (Mr. Paulin) was of the opinion, however, that it was very difficult to see such potentialities in a boy until he had attained a certain age. His experience was that there were qualities in boys which were not realised until later on in life, when some emergency compelled them to come to the front.

The idealist who so strongly condemned the present day tendency in factory work towards monotony utterly failed to appreciate its value in providing a higher standard of living for unskilled men with accompanying shorter hours. His idea seemed to be that the man who produced the iron ore should also produce the finished article, but, of course, if this were the case many people would not be able to make a living. There was one thing it would do, however, and that is, it would produce that pride of achievement which, unfortunately, modern methods tended to dampen.

He agreed with the lecturer that much good would accrue if suitable arrangements could be made to bring craftsmen of each industry together in an easy, social atmosphere that would permit a free interchange of opinions and experiences, to create such an atmosphere as would overcome the modest hesitancy of the craftsman who, at an ordinary meeting such as this prefers the rôle of listener. There is no doubt that this hesitancy is rooted in the belief that the knowledge and experience he has gained, and which is so familiar to him, has therefore become almost a commonplace with him, and could be of no particular benefit or value to the rest of the audience.

MR. A. LOGAN said the lecturer brought up one very practical question, namely, the training of foundry apprentices. A scheme such as Major Appleyard had suggested, regarding the co-operative employment of an instructor, he believed, was, to some extent, in operation on the Continent; also it could be adopted on the Tyneside, he thought, if the owners could be sufficiently interested.

MR. J. W. FRIER, speaking with reference to Major Appleyard's suggestion of throwing the works open to the men's relatives and friends, said he thought that this idea was well worth recommending. He remembered that on one occasion the works with which he was connected did this, and it was surprising what a large number of visitors they had and how interested they all were in everything. He supposed many works would like to do this, but were held back by the fact that they would like to entertain their visitors when they came, and did not feel at liberty to do so under present trade conditions.

As regards the training of apprentices, as Mr. Logan had mentioned, this was done on the Continent in some of the shops he had seen. Every apprentice when he first started was taken into a school and given a certain amount of education which was considered necessary for his foundry career. Then, if he showed ability he was sent into the foundry, but if not, he was rejected as useless. By this method they turned out really skilled apprentices. The manager of one of the works told him that the scheme worked well, and the only thing was that other people received the benefit from it, because as soon as the lad had finished his apprenticeship he would leave and get a better job. In that case it was the apprentice who derived the benefit and not always the people who trained him.

He also thought that the idea of having some kind of club in which the foundrymen could meet together was a good one. As trade revived and people became more contented than they were at present there would be a greater hope of attaining the ideals which Major Appleyard had put forward.

MR. J. E. O. LITTLE said he noticed that everyone present keenly supported the lecturer's ideals for the improvement of the conditions of the craftsman. The point was, however, whether people would really do something or merely continue talking about it. Why not have a committee formed with this objective in view? Why should not the foundrymen of Tyneside be first in the field in this connection as well as in others.

Canadian Conditions.

MR. F. ROBSON said that he had worked in a foundry in Canada which employed instructors, and it was amazing to see the progress their apprentices made. Also some mention had been made about foundrymen wearing overalls. He had also been in a shop in that Dominion where every man wore an overall, and was provided with a locker of his own in which to keep such things. When the men went home at night it was impossible to tell that they were moulders. If they can do this sort of thing in Canada we also can do it, but he was afraid there did not seem to be much sign of it as yet.

MR. C. R. VAN DER BEN said the lecturer spoke of educating the foundry apprentice and making a skilled man of him, but, at the same time, he admitted that the position of the skilled man at the present time was not sufficiently above that of the semi-skilled to make it worth while. He should like to know if, in the future, the skilled worker was to have a position which would be an incentive to lads to serve their time or if the lads must first be in a position to command improved conditions.

MR. C. GRESTY said that he was very pleased to note the reference to the part that the Institute was taking in the very work Major Appleyard was advocating. It might interest Major Appleyard to know that in the Newcastle Branch the great majority of the new members this session were actually working moulders. Most of these men had joined because other members had gone back to their foundries after the meetings and talked of the interesting time they had had. In this way the Institute had done much good work.

MR. V. L. BANKS pointed out that when an apprentice started work he was usually straight from school, and had very little notion as to the nature of an engineering works. He thought it would be a good idea, therefore, if a boy was sent into each shop for, say, a couple of months and learnt something of the trade he would like to enter.

MR. STOBIE heartily agreed with this, and pointed out that, by taking a lad round and let-

* This Paper appeared in our last issue.

ting him see the different shops, he was given a chance of choosing a trade which could hold his interest all through life.

THE AUTHOR'S REPLY.

MAJOR APPLEYARD expressed pleasure at the kind reception which he had been given by the members. In reply to the question as to whether the difference in the financial status was to precede the difference in the human status, or *vice versa*, the lecturer thought that, undoubtedly, before any marked attraction for a clever boy to enter a trade could be found, there would need to be a greater difference in financial status between skilled trade and semi-skilled trade. Therefore, he thought that the financial side of the question must be the more pressing one.

Mr. Stobie had raised the interesting point as to the displacing of the skilled man by the unskilled. It was perfectly true that by the introduction of machines there was a tendency to eliminate, in stages, the need for skilled men, and it was not to be forgotten that it required skill and brains to make those machines.

Years ago bolts were made by skilled men, but not so nowadays. One used to see six lathes worked by six skilled men, all turning out bolts, but now the work is done by, perhaps, six automatic machines, with one semi-skilled man in charge, which turn out far greater quantities of bolts. He very much doubted, however, whether it was possible to use all the six skilled men in making the six machines. This question of displacement of labour was, of course, one of the most vital questions of the day.

He remembered that years ago the coal trade wanted to install coal-cutting machines, but the miners definitely refused to have them, and their reason for so doing was that it would displace skilled men. Where these machines had been adopted there was no doubt that some skilled men had been deprived of their immediate work, and yet the number of skilled men employed in the industry, on a whole, had not decreased. The installation of machinery had increased output and caused collieries to develop where they would never have developed without it.

He (Major Appleyard) was a great believer in men having some place where they could meet together and have discussions. He would like to mention that in the county of Durham there were numerous places for miners which were in the form of clubs or lodges, and there they sat in the evenings and discussed their problems, and it was amazing what an educational atmosphere there was about the places. The men like to meet together under such conditions because they feel free and at their ease to talk, and also men living in more or less outlying districts cannot always get to official meetings, but they do like somewhere in their own town or village where they can meet together.

Cleanliness in American Shops.

When he was in America some time ago he was astonished at the cleanliness of the shops there, and one day he asked one of the managers how it was that the men kept their machines so clean. His reply was that they had first started the plan of giving £1 reward to the man who kept his machine the cleanest in the shop. This was not successful, however, because it was found that the man with the dirtiest machine was very often the man who did the most work, whereas another man did very little work and got the reward for a clean machine because he was able to spend a lot of time on it. They abandoned this method, therefore, and now the machines are judged once a week, and the man with the dirtiest machine would find, on going in on the Monday morning, a board on his machine on which were the following words: "This is the Dirtiest Machine in the Shop." If any man got this board more than a fixed number of times he was dismissed, the result being that the men not only wanted to keep their machines clean but it also had the effect of encouraging them to keep the shop clean as well.

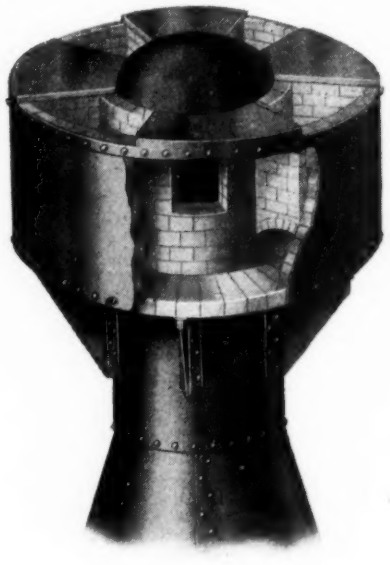
With regard to Mr. Frier's remark about other people getting the benefit of the training which a firm gave to its apprentices, he thought that the matter of training and status was such an important one that small personal matters of that kind would have to be overlooked. It was perfectly true that after a firm had trained a number of apprentices they might leave and go to another place, but, on the other hand, if one trained a boy it was one's business to try to keep him. If he did leave, however, he was not going to be any discredit to his firm, and if other firms were training their apprentices one would get some good ones in return, and eventually things would be levelled up.

He was interested to hear about the instructors in the works in Canada and in the States and of the provision of overalls for the men. He himself had seen all this done, and that was why he did not think that some of the ideas which he had put forward were impracticable. In those countries there was no doubt that they did study the psychology of their men to a greater extent than here, and were rather more progressive in matters of instruction and general training of apprentices in the various shops. It was the common practice all over, of course, to let an apprentice in an engineering works spend a certain amount of time in the different shops, but the curious thing was that the foundry and the pattern-shop were often the two departments into which boys were not sent. He was thoroughly in favour of an apprentice being sent round all the shops before he decided which trade he would enter.

A Novel Cupola Spark Arrester.

A spark arrester of distinctly new and original design is illustrated below. It has recently been placed on the market by the Pneulec Machinery Company, of Smethwick, Birmingham.

The chimney of the cupola to be served is covered with a steel dome, lined with firebricks. Four ports are provided in the walls of the chimney immediately under the dome. Each port leads into a collecting chamber formed in the outer casing or tank. The bottom halves of the cross walls of these chambers are cut away on either side to allow passage of gases to the atmosphere.



THE PNEULEC SPARK ARRESTER.

The sparks, in their passage through the collecting chambers, strike the side walls or roof and fall to the bottom, from whence they can readily be raked through the doors provided on the outside casing. A good feature is that no steelwork is exposed to the heat, all flues, baffle plates, and collecting chambers being firebrick lined.

From the foregoing it will be seen that the gases are allowed free access to the air, but obstruction is offered to the sparks, keeping them confined to the chambers. This spark arrester is known as the "B Type Special."

The Institute of British Foundrymen.

BIRMINGHAM, COVENTRY AND WEST MIDLANDS BRANCH.

The December monthly meeting of the Branch was held at 72, John Bright Street, Birmingham.

The Branch-President (Mr. D. H. Wood), in appealing to the members to introduce as many new members as possible, claimed that the Institute included in its ranks the best men in the foundry industry to-day. It must be obvious, he said, that those who joined the Institute did so for the purpose of increasing their knowledge of the industry in which they were engaged. But their motive was not one purely of personal gain but in order to profit by whatever information could be gained which was calculated to help them in the ancient craft of founding. This applied to all ranks—whether employers, foundry superintendents, foremen, moulders and pattern makers. It was therefore only reasonable that employers who were looking out for new men should favour those who, by joining the Institute, had shown their desire to increase their knowledge and better fit themselves for undertaking more responsible positions. He apologised for continually emphasising the need for increased membership, but personally he would not be satisfied until the Birmingham, Coventry and West Midlands Branch had a membership of 500.

The Production of Light Grey-iron Castings.

A Paper dealing with the production of light grey-iron castings was read by Mr. D. McQueen. He said the main considerations in an iron for light castings were that it should be fluid so as to run the thin castings and also soft, as a large percentage of the castings had to be drilled and some polished. The silicon content was of great importance and should be about 2½ to 3 per cent. They often found, however, that the silicon was higher than 3 per cent. or lower than 2.5 per cent., but it should never be under 2 per cent. Higher silicon irons were sometimes used either with a large percentage of scrap or with pig-irons containing low silicon so as to bring the average up to the proper amount. Such iron was often called glazed pig, and might contain 4 per cent. up to even 6 per cent of silicon. It was melted under abnormal conditions in the blast furnace, usually when blowing in or blowing out a furnace, or on other occasions when a larger proportion of coke was being used to the burden of ore than was normally required. In making light work the iron was usually run from the cupola as melted, and if a quantity of the high silicon iron was melted by itself the castings would be very hard and brittle and practically useless. This might happen, especially towards the end of the blow, if the cupola became dirty and was melting slowly. The effect on the castings was similar to what happened with high sulphur, the only difference being that the fracture was not quite so bright as that obtained with a high sulphur content.

Ferro-silicon was also used on some occasions where a small portion of the work might be exceptionally light, and this was usually added to the ladle or bogie before the molten iron was run in. It was usually reckoned that about 10 per cent. of the silicon was lost in remelting and the diminution in the silicon was thus one of the reasons why iron was harder after each remelt. Silicon was one of the variable elements in pig-iron; it was higher in No. 3 pig than in No. 4 and in No. 1 than in No. 3. Phosphorus was usually present in iron for light work to about 1.5 per cent. It was sometimes found in larger quantity, but he did not think it should be too high. High-phosphorus helped the running of the iron, but if silicon was fairly high the phosphorus could drop down to 1 per cent. or even less without doing much harm. Phosphorus was not lost in remelting.

Influence of Manganese.

Manganese was not always considered of great importance in work of this sort, and might vary considerably. About 0.6 per cent. he considered a quite good average, although many irons contained less. Where castings are required to stand water-pressure, the manganese should be present in larger proportion, as it gave a closer grained casting. Manganese was always lost in the cupola, especially when present in fairly large proportion.

Sulphur in Light Castings.

Sulphur was not usually found to any extent in the pig-iron manufactured for light castings, 0.05 per cent. and less being quite a usual figure. The main cause of trouble with sulphur so far as the foundry was concerned was when the iron picked it up from the coke in its passage through the cupola. Coke for good work should not contain sulphur over 0.8 per cent., although it was often up to 1 per cent. or even more. The greatest trouble from this cause was found in the first and second charges, and was caused by the long time the iron was in contact with the bed of coke while the cupola was being charged and before the blast was put on. After melting had begun there was not the same chance of the sulphur being picked up, and if the cupola was working well no further trouble might be met with throughout the melt. In passing through the cupola iron always increased its sulphur content, and this was a further cause of iron becoming harder after each remelt. Sulphur, of course, if present in sufficient quantity would make the castings white, very brittle, and non-machinable, as thin castings were so quickly cooled and thus easily chilled. He remembered a casting of a grate bar coming back from a customer after being a short time in use melted through in the centre and showing very white iron when broken near the melted part. The remainder of the casting was quite normal, containing 0.05 per cent. sulphur, while the melted part contained over 2 per cent. It certainly seemed a mysterious casting and a report upon it was to the effect that segregation of the sulphur in the iron had taken place. His own view was that it had originally been a blown casting, that the fire had made the thinner part, where the blow was, white hot, and that while in this state it took up the sulphur from the fuel burning in the grate.

Influence of Carbon.

Total carbon should not exceed 3.5 to 3.6 per cent., although larger amounts were often present. Graphitic and combined carbon were present according to the proportion of other elements. In the pig-iron used for light castings the bulk of the carbon was in graphitic form, very little combined carbon being present. The combined carbon increased, however, in the cupola, and was always higher in the casting. It was usually considered that in light work about one-third of the cast came back as scrap from gates, runners, etc., so that although using only one's own scrap, there was always a fair percentage in the charge. Moreover, some people bought outside scrap, and the proportion was sometimes as great as half pig-iron and half scrap, on occasion, for one cast. The iron was run from the cupola as melted, as it must be delivered to the moulder in a hot state.

Mis-run Castings.

One of the troubles that beset the light casting moulder was mis-run castings. Though the iron might be suitable for the work so far as composition was concerned, if it was not sufficiently hot it would not run the full length of the casting. This fault, however, was not always attributable to the iron, but was often caused in the case of plate moulding by the plate not lying properly on the fitting strips of the boxes. The result was that when the plate pattern was withdrawn and the box closed, thickness was lost and the iron was not capable of running over that very thin part. The moulder in the engineering shop had his difficulties in giving a clean machining face, and similarly the moulder in the light casting shop had to

produce a clean surface for polishing, although in this case there was very little metal taken off. Also where variations of thickness occurred they might have a drawing or sinking.

Sands for Light Work.

As to sands, Mr. McQueen said the sand for light work required to be fine, and it was often improved by milling, especially in the case of the sand to be used for the facing. This facing sand, made up from new and used sand, had coal dust mixed with it to provide the mould with an insulating material to protect it from the action of the iron. This was the most important facing for light ornamental work. A little wood blacking was usually used in conjunction with the coal-dust facing, although in some cases this was not found to be necessary.

Moulding Methods.

Much the greater proportion of the work in the light foundry was of a repetition nature and was largely worked by means of the plate-pattern method, which, roughly speaking, halved the cost and doubled the production per man, besides simplifying the work considerably and making it really of a less skilled nature. The initial cost of this form of pattern was higher than with the loose pattern, but when large quantities were required this was soon more than made up. Where the numbers required would not pay for a plate pattern, there were various methods of working with odd sides adapted for the loose patterns. The plate patterns were usually made in cast iron. Some preferred to have a plain plate and fix the patterns on, as in this way they could use the same plates for various patterns, but it was not every style of pattern that was suitable. Though cast iron was the usual metal, sometimes aluminium was used for larger plates so as to reduce the weight for lifting. Aluminium was also used in some cases where the partings were nearly perpendicular, as the cast-iron plate was weak at such places and easily broken. Sometimes a plate and loose pattern were used in combination on the same job, when the presence of the plate simplified the operation very considerably. Moulding machines were not used to a very great extent in the foundries principally engaged on stove work, though a few machines were usually found in most shops. For ordinary flat work it would require a very efficient machine to increase production as compared with floor moulding using the pattern plate, although there were many other jobs where machines proved very useful. Snap-flask work on the usual type of press machines was pretty general for the smaller castings. There were many types of machines for special jobs, and he recalled having seen one for hollow castings where the ramming was accomplished by means of compressed air inside rubber plaques. One great difficulty in the making of light castings was due to warping. It was very difficult to get a large, thin casting without bend of one sort or another. Generally it was caused by unequal cooling, which caused unequal contraction, which might or might not be caused by unequal thickness. The difficulty was usually overcome by putting a camber on the pattern or an extra thickness along the outside edges.

Discussion.

MR. HORRELL inquired whether the superior face on Scottish castings was due to the Erith sand facings that they used or to the iron.

MR. MCQUEEN replied that there were foundries in the Birmingham area producing work which was quite as good in this respect as any produced in Scotland. Even in the same shop different moulders turned out dissimilar work. Generally speaking, if they used the sand fine enough they would get a good skin. He did not think the iron had so much to do with the question. Replying to another question as to the usual proportions of new sand and coal dust required to produce a good skin, he said that in Scotland equal proportions of old and new sand were generally used. One of coal dust to about 15 to sand was successful for light castings.

On the motion of MR. F. C. EDWARDS, seconded by MR. J. B. JOHNSON, Mr. McQueen was warmly thanked for his address.

Use of Aluminium Paint Extending.

The employment of aluminium paint for both inside and outside work in place of the usual paints is greatly increasing in the United States, says Dr. Robert J. Anderson, consulting metallurgical engineer and expert on aluminium. Although aluminium paint has been employed to a subordinate extent for many years, the great expansion in its use has come in the past two years.

The aluminium powder for aluminium paint is made by stamping thin aluminium sheet or foil into minute flakes in a progressive stamping process. The small particles of metal are screened to various sizes, and form the aluminium powder of commerce. This powder is mixed with suitable vehicles, such as linseed oil of heavy body, spar varnish, lacquers, amyl acetate, and other bases, to form the paint. Aluminium powder for paint is furnished as polished and unpolished; the polished powder yields a highly reflecting and brilliant surface when applied as a paint.

Aluminium paint is valued for its great opacity, high reflectivity, corrosion-resisting and heat-insulating properties. It has great covering capacity, a gallon of the paint ordinarily covering about 750 sq. ft. of surface.

Aluminium paint is now being used very generally as an outside paint for painting oil tank trucks, oil storge tanks in oil farms, and other equipment in oil refineries, gas holders, structural steel work, in by-product coke plants, smoke stacks (both on land and on vessels), towers, water plugs, transformer tanks, and other purposes. When used for oil storage tanks, aluminium paint serves the double purpose of protecting the steel of the tank against corrosion and maintain the temperature low under exposure to the sun, thereby reducing volatilisation losses. A coat of aluminium paint applied to an automobile top shuts out 50 per cent. of the heat from the sun, and a coat applied to the underside of a tent shuts out about 85 per cent. of the sun's heat rays. A black automobile top absorbs about 90 per cent. of the sun's rays, and about half of this heat is re-radiated from the underside. The automobile top is only one of the applications to which aluminium paint is suitable where it is desired to keep the inside of an enclosure cool in the summer. Aluminium paint is used to paint the fabric of balloons and of the rigid type of dirigible ship like the Los Angeles, the object being to keep the inside cool and to protect from the action of the weather.

Aluminium paint is coming in considerably for use in covering interiors, particularly in factories and foundries. The reflectivity of aluminium paint for light may be as high as 70 per cent., *i.e.*, about 70 per cent. of the light striking a surface painted with aluminium is reflected, and the remaining 30 per cent. is absorbed. Greatly improved illumination comes in factories, warehouses, and other interiors by painting the walls with aluminium paint.

As is known, aluminium paint has been used for many years in covering multi-segmented house radiators. This is a most inefficient application, said Dr. Anderson, as the paint reduces the amount of heat radiated and increases fuel bills. The amount of heat dissipated by a radiator painted with aluminium paint may be 70 to 75 per cent. as much as when painted with lead or zinc oxide paints or enamels, chrome-coloured pigments, and the like. About 15 to 20 per cent. gain in heat can be made by using a non-metallic paint (*i.e.*, free from particles of metal like aluminium paint). The paint need not be black, but a dark green tint, such as is sometimes used, is good. The effect of aluminium paint on house radiators is not generally known, but it shows up every month on the coal or gas bills.

THE BUSINESS of Roberts & Cooper, Limited, who own the Bromley and Brettell Lane Ironworks, Brierley Hill, the Great Bridge Iron and Steel Works, Tipton, and Leys Ironworks, Brierley Hill, has been acquired by John Bradley & Company (Stourbridge), Limited, of Stourbridge. There is to be an amalgamation under the reorganisation scheme.

Suspended Open-Hearth Roofs.

For some time past the problem of efficient roof construction in open-hearth furnaces has been engaging the attention of steel manufacturers in the United States. In practice it has been found that the cost of renewing a roof about every 20 weeks or oftener, and the making of minor repairs at even more frequent intervals, constitute a serious problem. Attempts at a solution have been made (1) by efforts to discover better refractories than the silica bricks now used, and (2) by using the existing refractories to better advantage. A noteworthy development in the latter direction is the suspended roof, in which the bricks are supported from above and thus relieved of the crushing pressure involved in the sprung-arch construction.

A form of suspended roof construction has been developed which has the advantage that it can be

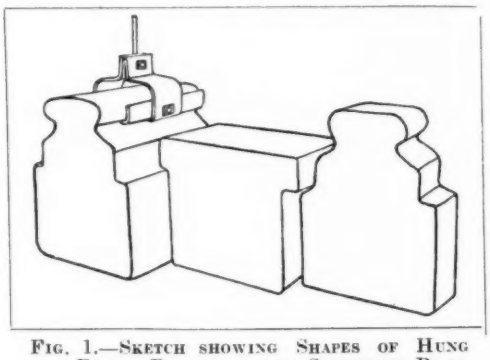


FIG. 1.—SKETCH SHOWING SHAPES OF HUNG AND FILLER BRICKS USED IN SUSPENDED ROOF.

applied to existing furnaces in place of the sprung-arch type without change of furnace lines likely to affect working conditions or operation. Fig. 1 shows a sketch of the form of silica bricks employed and the method of hanging them by exterior

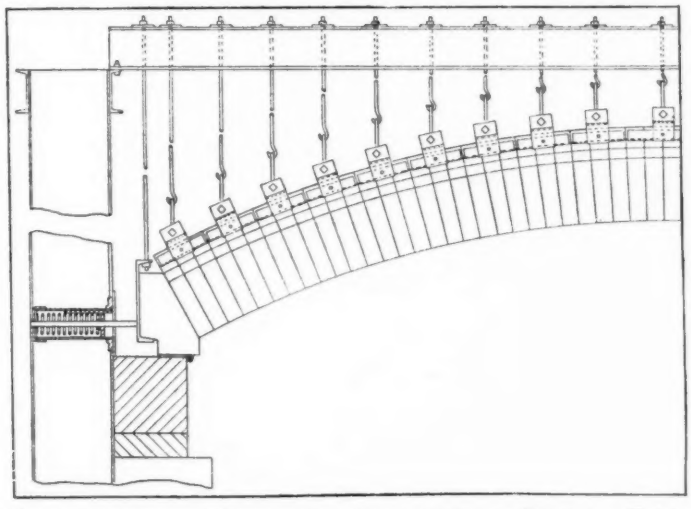


FIG. 2.—SECTION OF ROOF SHOWING ARRANGEMENT OF HUNG AND FILLER BRICKS AND METHOD OF SUSPENSION.

supports protected from the heat of the furnace. All the weight of the roof is carried vertically and therefore the load-carrying requirements of the bricks are reduced to their own weight. The possibility of buckling of the roof from expansion is relieved automatically by compression springs, as clearly indicated in Fig. 2. This arrangement, while ensuring brick-to-brick contact and tight joints, does not cause an increase in the rise of the roof when the furnace is heated, because the span increases to accommodate expansion.

Two silica shapes are used in the suspended roof. They are relatively small in size and offer no unusual difficulty in manufacture. The hung brick for a 12-in. roof is about 15¼-in. × 12-in. × 3-in., tapered to suit the required radius and having an extended head from which it is suspended. The filler brick for a 12-in. roof measures 12-in. × 12-in. × 3-in., also tapered. It has two lugs on the upper end which rest upon corresponding shoulders of the hung brick, as shown in Fig. 1. The hung brick and filler brick alternate in courses across the furnace with every cross joint a by-passed joint, which provides for longitudinal expansion of the roof by shingling the cross joints. As a rule standard skew blocks can be used in connection with the suspended roof.

The entire weight of the roof is carried vertically from channels resting on angles attached to the vertical buckstays. Each pair of angles and clips engage and support three hung bricks. Hook bolts carry each unit of three bricks from the overhead supports.

Compensation for expansion and contraction is provided by a series of compression springs encased in ventilated housings and placed between the buckstays. The spring pressure is exerted horizontally through spring rods against suspended skew channels which in turn support the skew blocks. The springs are set with an initial pressure just sufficient to maintain the roof bricks to radial lines and in close contact. While adjustment may be made in the springs to vary the initial pressure when application is made to furnaces of different widths, no subsequent adjustment is necessary while heating up and cooling off the furnace. Observation has shown that the span of a suspended roof on a furnace 14 ft. wide between walls increases an average of 1¾ in. during the heating-up period, as measured by the spring-rod travel.

In its article embodying descriptive details of this form of roof construction, the "Iron Trade Review" gives some facts and figures attending its use for the past two years in a 70-ton basic open-hearth furnace in the Ohio District, U.S.A., making steel of low carbon content. The life of a sprung-type roof on this furnace prior to the installation of the suspended roof averaged less than 200 heats. The furnace is fired with producer gas, is charged cold, and the heats run about 13 hours from tap to tap. The suspended roof survived 365 heats before it was necessary to entirely renew the silica bricks. This run consisted of two campaigns—one of 197 heats when partial repair was made and another of 168 heats. The second complete run netted 428 heats of three campaigns of 166, 123 and 139 heats respectively. Two partial repairs were made during this run. The furnace now is making steel after more than 300 heats, and gives promise of going 400 to 445 heats before the refractories will have to be renewed. Two repairs have been made thus far in this run. In no case in the two years of operation has it been necessary to cut short a campaign to repair the roof. The roof is 22 ft. long, entirely covering the bath. The ends have the usual sprung roof, since the furnace is of the camel-back type and the port sections were of such sharp inclination that it was difficult to design silica suspended shapes for this part.

Barbed Wire Substitute.—A substitute for barbed wire has been brought out recently by the German firm, Otto Wolff & Company, of Cologne. Punched from hoop iron of about No. 16 gauge and 2 in. wide, the slitting is such that a barbed wire substitute is produced by pulling the band until it is fully extended. Shipped in rolls before extension, the makers claim compactness and smoothness in handling. Although it is said that the present cost of production is in excess of the cost of producing barbed wire, the delivered price is lower, as the extended barbed band weighs less per foot than wire.

Making a Large Condenser Core.

By H. RICE.

The following article is not written with the object of teaching the coremaker his business or to cast any reflection on the methods of procedure of making a core of this description in this country. The writer's desire is to describe a device he saw adopted in a large marine foundry abroad, and which he considers to be an improvement on the system generally carried out.

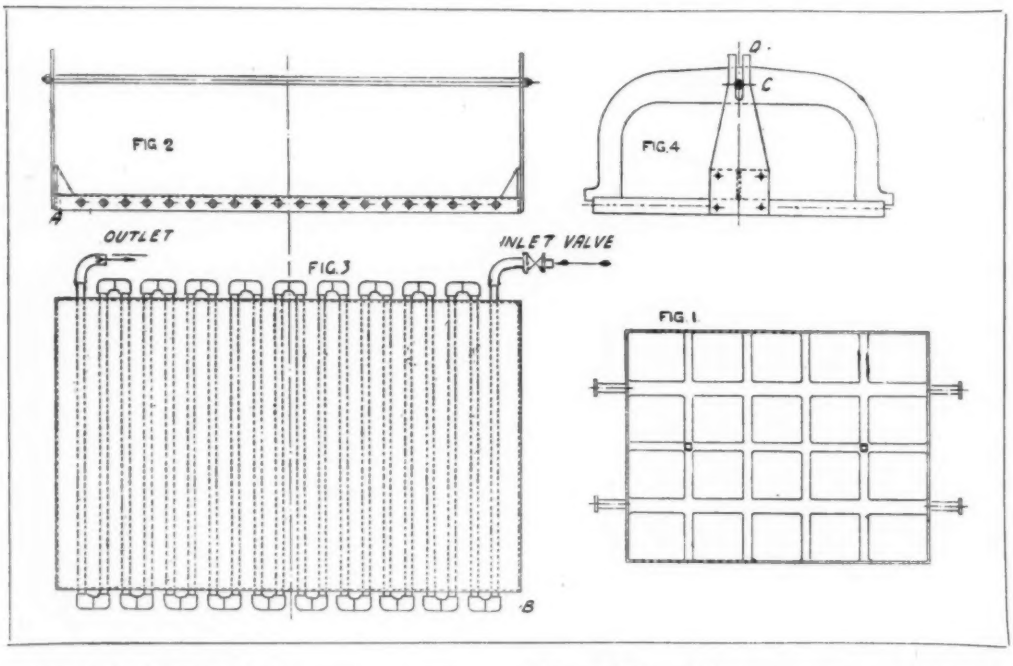
Most shops usually strike up a bed and work from a skeleton box, to build up the core; they are fully alive to the fact that the suction of the bed pulls the bottom off very often from the first grid (Fig. 1), which is described by the coremaker as a "bad clag," owing to the difficulty of turning over such cores, when the mending-up or patching has to be done overhead, which is no easy matter; in fact, the writer has known two men spend two days patching, and even then it had to be true up with straight-edges and carefully tried for thickness after drying, which means additional work all round, as well as holding up the crane, which is a serious item in a busy foundry.

If the management will go to the expense and outlay of the following plant it will soon compensate them for their trouble.

A surface plate should be made large enough to take the largest that may be called for, with cored holes, as shown at "A" (Fig. 2), to take 2-in. or 3-in. pipes, and carry them under the plate, as shown at "B" (Fig. 3), and connect them up with the hot-water pipes that usually heat the pattern shop, or with the engine house, so that a steady flow of hot water or steam passes through them during the building of the core, or, as an alternative, it may be heated by gas. It will be seen that as soon as the first layer of loam is placed in position the core commences to dry, and when finally built and lifted it will be quite clean and can be stoved at once. Fig. 4 shows the end of the surface plate with strickle in position, connected to a grooved pulley, which runs along a flat bar supported at each end by a bracket, as shown at "C" (Fig. 4); the brackets should be made with a slot or slide, so that they may be adjusted to suit any strickle, as shown at "D" (Fig. 4). This will save the strickle having to be passed backwards and forwards, as well as having the same effect as a spindle in a centre.

These improvements will be found beneficial and economical in competing with the foreign foundryman, since we must be sufficiently enterprising to adopt some of their labour-saving devices when the latter have points to commend them.

In conclusion, the writer would state that the surface plate can be put to the extended use in the making of oil cores for silencers, heaters, separators, and any large core that at present has to be made in loam or sand, owing to the risk of such cores in sea sand collapsing when the box is taken away, which is very often the case in large oil-sand cores due to insufficient binder, which must, of course, not be excessive for certain jobs, whereby they will not stand so easily in their green state, so that it will be readily seen that a distinct advantage is gained. Also, if not in use for building up cores, it can be used to prevent any cores or moulds that are already dry from striking damp again that may have to be left over from the cast, thus leaving the stove clear for green moulds and cores.



New Method for Determining Gases in Metals.

According to the "Iron Age," a very accurate method for determining the amounts of oxygen and hydrogen in metals has been developed recently by the American Bureau of Standards. The analysis, which will determine 1/1000 of a gramme of oxygen and 1/10,000 of a gramme of hydrogen in 100 grammes of iron or steel, is made by sealing a sample of the metal inside a fused-silica tube, evacuating the tube, melting the sample in a high-frequency induction furnace, and collecting and weighing all gases given off from the melted sample.

Although the great variety of steels and non-ferrous metals and alloys that are used so extensively in every-day life are carefully analysed at various stages in the process of manufacture, but little attention has been paid to the small amounts of gases which such metals are known to contain. In the case of steels and cast irons this rather general neglect of gases has been due to the lack of satisfactory methods for their determination, although it was realised that their presence or absence had an important effect on the properties of the metal. This difficulty is now believed to have been overcome.

A complete description of this investigation will be published as one of the Bureau's scientific papers.

THE UNITED METAL COMPANY, LIMITED, have removed to 8, Drapers' Gardens, London, E.C.2.

MR. H. MITCHELL has started business as an iron and steel merchant at 49, Cadogan Street, Glasgow, trading as Hugh Mitchell & Company.

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1.—The initial cost is very low.
2.—Old sand can be used in the proportion of 3 parts Old Sand to 1 part New Sand.
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For Doncaster, Worksop and similar sands, 1¼ lbs. Binder to 1 cwt. sand.

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In all cases add a little dilute Binder to the Blacking Wash, to prevent "washing off."

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The Binder is supplied as a **Liquid Essence** and must be diluted with Water for use. Mix the correct quantity, as given above, with about four times its weight of water and add this to the Core Sand. Mix thoroughly to avoid patches in the Cores, and damp down with water to reach the desired consistency.

THE CHEAPEST AND MOST EFFECTIVE BINDER FOR THE FOUNDRY.

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METALLURGICAL AND FOUNDRY SPECIALISTS.

Trade Talk.

ALLEN-LIVERSIDGE, LIMITED, have just registered a company in Bombay under the name of Allen-Liversidge (India), Limited.

SUTCLIFFE BROS. & BRYCE, LIMITED, Globe Works, Hyde, have opened an office at St. Martin's Chambers, Bull Ring, Birmingham.

A FIRE RECENTLY broke out in a large steel warehouse at the River Don Works of Vickers, Limited. The flames enveloped and completely destroyed the roof.

THE LONDON & NORTH-EASTERN RAILWAY COMPANY are stated to have placed orders for 33,000 tons of steel rails in Great Britain, but details are not yet available.

JAMES CARTER (STALYBRIDGE), LIMITED, iron and brass founders, etc., Stalybridge, Cheshire, have established a London office at 75, Mark Lane, E.C.3, and have placed Mr. A. Brown in charge.

THE UNDERFEED STOKER COMPANY, LIMITED, have orders for 23 self-contained stokers, 2 Underfeed stokers, 4 ash and coal conveyors, 2 powdered fuel plants, 2 air heaters, and 12 Detrick arches.

THE METROPOLITAN VICKERS ELECTRICAL COMPANY, LIMITED, Trafford Park, Manchester, have booked a contract with the Oldham Corporation for a new power station, comprising three 12,500-k.w. turbo-generator sets and condensers.

SCOTT'S SHIPBUILDING AND ENGINEERING COMPANY, LIMITED, Greenock, have received a contract from London owners to build two vessels of the shelter-deck type, each of 8,500 tons deadweight. They will be fitted with twin reciprocating engines.

THE RECENT EXPLOSION which occurred at the Acklam Ironworks of Dorman, Long & Company, Limited, caused a temporary dislocation of the plant, which, however, was quickly remedied and operations were resumed in a few hours. Three men were injured.

THE RESULT OF THE TENDERS for the first lot of rails and accessories for the Bulgarian railways, consisting of 15,000 tons out of a total of 69,000 tons, is to be announced in Sofia on January 25. A circular of the Finance Ministry states that successful foreign firms will have to pay the tax on profits.

EXTENSIVE ALTERATIONS are to be carried out at the Birkenhead shipyard of Cammell, Laird & Company, Limited. Hitherto the company's smaller slips have been only sufficient to build ships of a length up to 200 ft. The extension will provide facilities equal to the construction of ships up to 500 ft. in length.

WILLIAM GRAY & COMPANY, LIMITED, have an order for a further steamer, the fourth in the past few months. The vessel, which will be a general cargo boat of single deck long bridge type of about 9,000 tons deadweight, is to be built at the Central Shipyard, West Hartlepool, and engined at the Central Marine Engine Works.

THE CHESTER HYDRAULIC ENGINEERING WORKS, LIMITED, has secured an important contract from the Mersey Docks and Harbour Board for the hydraulic gate operating machinery for the new lock entrance and inner passage serving the Alfred Dock, Birkenhead, the gates for which are to be supplied by Sir W. G. Armstrong Whitworth & Company Limited, under another contract.

THE ERECTION of the new telephone exchange at Manchester will necessitate the use of 4,000 tons of steel. The building, for which the contract has just been placed with Messrs. Gerrard, of Swinton, is being erected in view of the projected switching over of Manchester's telephone service from the manual to the automatic system, and will take three years to complete. It will occupy a floor space of six acres, and will cost altogether some £250,000. Three units of automatic apparatus, each dealing with 10,000 lines—30,000 lines in all—will be accommodated.

MR. H. HIPKISS, late partner of the Midland Bright Drawn Steel and Engineering Company Portway Road, Wednesbury, has now removed the whole of the bright drawing plant to more commodious premises situate at Richmond Works, West Bromwich, where there is every facility for a greatly improved output of bright drawn steel bars. The above will continue to trade as the Midland Bright Drawn Steel and Engineering Company, Limited. Mr. E. G. Prothero will remain at the old premises for the manufacture of solid drawn steel tubes, trading as the Prothero Steel Tube Company, Limited.

JOHN RUSSELL & COMPANY, LIMITED, of the Alma Tube Works and Cyclops Ironworks, Walsall, and of the Old Patent Tube Works, Wednesbury, have acquired 100 acres at Halton, Cheshire, for erecting works. These, it is stated, will be equipped with the most modern plant. Upwards of 1,000 men will be employed when the works are in full operation, and an option has been obtained on fifty acres as a building site for workmen's dwellings. The reason for the transfer from Walsall is to overcome the heavy rail charges and other transport difficulties by obtaining direct access to the sea.

Obituary.

MR. F. B. SUMMERS, J.P., of Froyle Place, Hants, died on January 7, aged 60. He was a director of John Summers & Sons, Limited, Shotton, Chester, and Stalybridge.

MR. T. PURVIS died at his residence, 5, Graingerville, Newcastle, on January 7, after a brief illness. He was a former member of the staff of Sir W. G. Armstrong, Whitworth & Company, Limited. Mr. Purvis, who was in his 78th year, served at Elswick Works for 53 years, the major portion of which period he was head of the commercial staff of the Ordnance Department.

Contracts Open.

Cheltenham, January 30.—Iron and steel during year ending March 31, 1927, for the Corporation. Mr. J. S. Pickering, borough engineer, Municipal Offices, Cheltenham.

Kilmarnock. — Pipes, for the Corporation Waterworks. Mr. W. Dunbar, water engineer, Kilmarnock.

London, S.W., February 11.—Iron and steel, etc., from March 31, 1926, for periods of six or 12 months, for the Lambeth Borough Council. Mr. O. Cattlin (chartered civil engineer), borough engineer, Town Hall, Brixton Hill, London, S.W.2.

Melbourne, February 7.—Crossings, for the Victorian Government Railways. The Department of Overseas Trade (Room 50).

Shardlow, February 5. — Pipes, for the Shardlow R.D.C. Elliott & Brown, chartered civil engineers, Burton Buildings, Parliament Street, Nottingham. (Fee, £5 5s., returnable.)

New Companies.

Allied Magnesite Industries (Euboea), Limited.—Capital £200,000 in £1 shares. Directors: A. E. B. Rose, L. N. Schoenfeld, A. M. Harris, H. W. Young, H. L. de Caux, J. H. Infield and T. E. Comins. Solicitors: Boyce and Evans, 14, Stratford Place, London, W.1.

Arjays, Limited, 73, Basinghall Street, London, E.C.2.—Capital £5,000 in £1 shares. Machinery dealers. Directors: R. Joseph, D. W. Henley, and G. H Olley.

Ben. Bennett, jun., Limited, National Provincial Bank Buildings, Doncaster Gate, Rotherham.—Capital £5,000 in £1 shares. Iron merchants.

Breeden & Company, Limited, New Mill Works, Fazeley Street, Birmingham. — Capital £1,000 in £1 shares. General iron, steel and brass founders, etc. Director: W. J. G. Sperryn.

Brunswick Metal Casement & Engineering Company, Limited. — Capital £2,000 in £1 shares. Directors: W. E. Plaister, W. F. Ward and E. J. Kerslake.

John Thomas (Junior) & Company, Limited, 8 Zetland Buildings, Munton Road, Middlesbrough.—Capital £5,000 in £1 shares. Iron, steel, metal, machinery, coal, coke, and scrap metal merchants, etc. Directors: J. A. Thomas (permanent governing director and chairman) and A. Thomas, Braeside, Marton, S.O., Yorks.

N. C. Metal Company, Limited, 49, Cannon Street, London, E.C.4.—Capital £10,000 in £1 shares. Directors: Ludwig Wiese and H. Edwin Coley.

Pybus, Westgarth and Patterson, Limited.—Capital £2,000 in £1 shares (1,000 7½ per cent. cumulative preference and 1,000 ordinary). Metal brokers, etc. Directors: A. Pybus, 64, Wolseley Gardens, Newcastle; J. Westgarth, and F. A. Patterson.

Measuring Air Flow.—According to a Paper read by Mr. E. Ower before a meeting of the Institution of Heating and Ventilating Engineers, the problem of accurately measuring the flow of air is complicated by the fact that the motion is invisible, and methods applicable to the movements of liquids cannot be used. Dealing with manometers, the author described three types suitable for factory work. For all-round usefulness combined with accuracy and ease of observation, he advocated the Krell form of inclined tube manometer; the only disadvantage of this instrument was that it was not a fundamental standard and required calibration. Reference was also made to a tilting micro-manometer, whose calibration could be calculated from a knowledge of its dimensions, and to a two-liquid gauge. The latter was of value for work where high precision was not needed, but greater accuracy was required than could be obtained from an ordinary U-tube water gauge.

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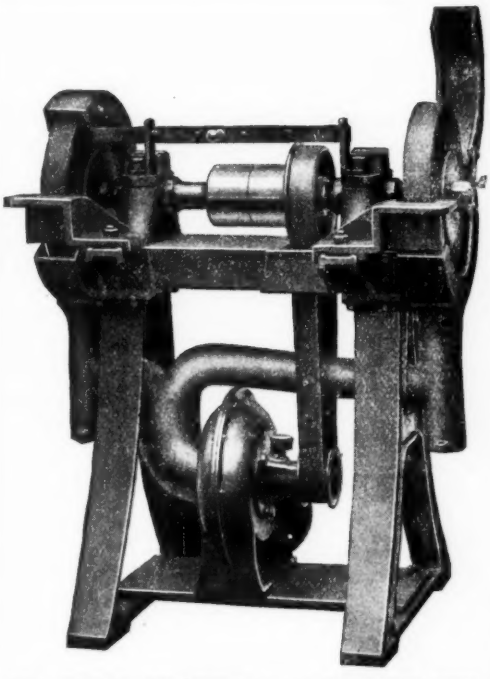

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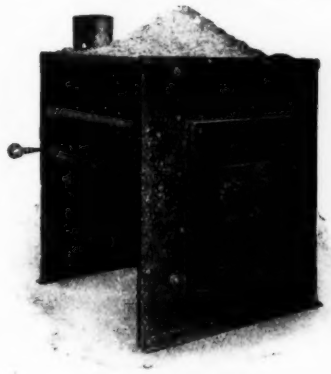

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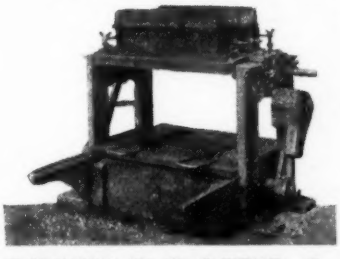

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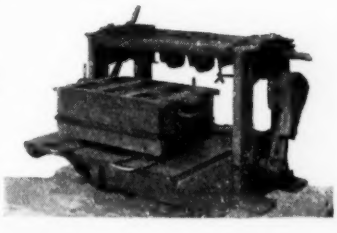

Patentees and Makers:

JOHN BOOTH & SONS, *General Ironfounders,* **RIPPONDEN, nr. HALIFAX.**

IRON AND STEEL MARKETS.

Pig-Iron.

MIDDLESBROUGH.—Conditions in the Cleveland iron market during the past week have fully maintained the strength previously reported, and at the moment it is difficult to place forward business where large tonnages are required. Stocks of foundry pig in makers' yards are becoming rapidly exhausted, and with the present fuel costs, and the uncertainty of the future position of the mines, makers are naturally reluctant to increase production until the situation in this respect is more clearly defined. In the export section there is but little change. A moderate amount of business in foundry iron is passing at the enhanced rates, notwithstanding the lower Continental quotations. The following are this week's minimum quotations for export, f.o.b., home prices being 6d. per ton less :—No. 1, 73s. ; No. 3 G.M.B., 70s. 6d. ; No. 4 foundry, 69s. 6d. ; No. 4 forge, 68s. 6d. per ton.

The market for hematite iron on Tees-side is, if anything, shorter of supplies than is the foundry iron section, and prompt deliveries are unobtainable, only moderate quantities being offered for February-March delivery. Home demand is fully maintained, and sales to the Continent would appear to be steadily improving. There has been no change in quotations, but prices are extremely firm at previous levels, viz. : No. 1, 78s. per ton; mixed numbers, 77s. 6d. per ton. On the North-West area prices of Bessemer mixed numbers have been advanced, the quotation per ton delivered at Glasgow being £4 7s. 6d. per ton; at Sheffield £4 10s. 6d. per ton, and at Birmingham £4 13s. 6d. per ton.

LANCASHIRE.—Business in the local markets for foundry iron has been on a somewhat improved scale of late, with prices distinctly firmer than has been experienced for some time past. In some cases sellers do not seem inclined to book very large quantities, preferring to keep some margin for early advances, which is their estimate of the course of the market. Some of the foundry branches are proving extremely good customers, their consumptive requirements being very large.

THE MIDLANDS.—The demand for foundry pig in this district also indicates a progressive tendency, and substantial orders have been recently negotiated. There has been a fair amount of forward buying by merchants and consumers, but the latter have not bought as far ahead as they would like, as the furnaces are not anxious sellers beyond February/March, presumably on account of the uncertain situation respecting coke. Ruling quotations are as follow:—Derbyshire No. 3 foundry, 67s.; Staffordshire No. 3 foundry, 67s.; Northants No. 3 foundry, 63s. 6d. to 64s.

SCOTLAND.—There has been a better demand for Scotch iron of late, especially for export, and some fairly good parcels have been booked, but, generally speaking, consumers are still taking very little interest in the market. Owing to a dispute in regard to wages, three furnaces have been blown out at Summerlee Works, and, whilst this has tended to give a firmer tone to the market, there is no change in prices, and No. 3 foundry Scotch is still obtainable at 76s. 6d., or even a shade less, at the furnaces.

Finished Iron.

The improvement in demand disclosed at last week's quarterly meeting for this class of material is well maintained as regards crown quality bars, for which it is reported that just under £11 5s. has been taken in certain instances, although the general figure is £11 7s. 6d. to £11 10s. As recently suggested, the fact that there will be considerable delays on some of the Belgian orders has had the result of bringing more orders to the local manufacturers of bolt iron, who at the present time are quoting £10 5s. to £10 7s. 6d. per ton for this grade. Belgian quotations have appreciated from £7 up to about £7 5s. per ton delivered for delivery as far forward as March/April. It is not reported that there is any outstanding improvement in the demand for marked bars, which are still quoted at £14 at makers' works. Recently business has been very quiet for this quality, but the position has improved somewhat since then, although the makers have but a poor order book at this juncture.

Steel.

The position in the steel industry continues to improve as previously recorded, and it is now hoped that the anticipation of further active business may be realised in the near future. The call for sheet and tinplate bars remains very fair, but is undoubtedly being helped by the delay in deliveries of Continental products. In fact, several of the works are quite busy. The price of both qualities remains at £6 5s. per ton delivered, which is approximately 20s. higher than the figure quoted by foreign makers. In regard to billets, the demand is very poor, but the larger portion of the business is being taken by Continental rollers, although their prices are inclined to stiffen. Small steel bar prices are tending upwards. It is doubtful whether English makers, who accepted £7 7s. 6d. during the recent depression, will now take less than £7 12s. 6d. for approved specifications. In the steelworks generally booking has been fairly heavy during the past fortnight. A number of the works have now booked orders sufficient to keep them in continuous operation over the first quarter of the year.

Scrap.

Although slow in improvement as compared with pig-iron markets, the demand for scrap metals is certainly better, and in Sheffield especially dealers are holding firmly to values for all classes of material. Recently they were ready to make concessions in some directions, but to-day they will not accept business at cut prices. Cast scrap is not much inquired for, but rather more attention is being given to broken machinery scrap in this area at about 70s. or 72s. 6d. per ton delivered. In Scotland, with the slight improvement in pig-iron, machinery cast-iron scrap has also firmed to 75s. per ton, and for ordinary cast to the same specification, i.e., pieces not exceeding 1 cwt., 67s. 6d. to 68s. 6d. per ton. Old cast-iron railway chairs have also been disposed of at 72s. 6d. to 75s. per ton, light cast-iron scrap and firebars at 57s. 6d. to 60s., and for re-rolling rails there is practically no change at 65s. to 67s. 6d. per ton. The above prices are all per ton, delivered f.o.t. consumers' works.

Metals.

Copper.—Values of standard copper are fairly steady on the whole, considering a somewhat decreased demand, usually experienced at the turn of the year. With the works in operation again, however, consumption should shortly begin to show some life. Fortunately for the smelters values have not suffered in the meantime, despite the fact that the cables received from across the water are lacking in bullish tone, although it is evident that consumption in the United states remains substantial. Current quotations :—*Cash* : Thursday, £59 7s. 6d. ; Friday, £59 7s. 6d. ; Monday, £58 15s. ; Tuesday, £58 15s. ; Wednesday, £58 15s.

Three Months : Thursday, £60 10s. ; Friday, £60 7s. 6d. ; Monday, £59 17s. 6d. ; Tuesday, £59 17s. 6d. ; Wednesday, £59 17s. 6d.

Tin.—The decline in this metal, now amounting to £6 per ton so far for the current month, has undoubtedly been largely due to substantial realisations, in face of which values are seldom able to survive. The outlook, however, continues to inspire confidence, while it is quite on the cards that America will be compelled to re-enter the market for considerable quantities. The fact that option contracts of some importance are falling due shortly has somewhat complicated the situation, and for this reason it is quite possible that the near future will see rather sharp fluctuations. Meanwhile, home stocks are very low. Current quotations :—*Cash* : Thursday, £283 15s. ; Friday, £283 10s. ; Monday, £281 ; Tuesday, £279 5s. ; Wednesday, £279.

Three Months : Thursday, £276 10s. ; Friday, £276 5s. ; Monday, £274 10s. ; Tuesday, £273 10s. ; Wednesday, £274 5s.

Spelter.—With reference to this metal, a trade circular states : " Fairly active conditions have prevailed, buyers on the whole showing rather more interest, with some revival of speculative demand. Consumers' inquiry has been slow, but, at the same time, there has been no great pressure to sell, and nothing to speak of has been offering from Germany. The market in America remains quietly firm, and, by reason of the wide disparity in price between New York and London, business is still impracticable. Current quotations :—*Ordinary* : Thursday, £38 13s. 9d. ; Friday, £38 10s. ; Monday, £37 15s. ; Tuesday, £37 12s. 6d. ; Wednesday, £37 16s. 3d.

Lead.—The recent weakness in the prices of foreign pig has been due to a dragging demand from consumers and the existence of large surplus supplies held privately, which are adverse to a revival of confidence, and consequently the market may yet fall further. It is unfortunate that consumption has fallen off considerably, and production, under the stimulus of high prices, is evidently somewhat more than can be readily absorbed at the moment. Current quotations :—*Soft foreign (prompt)* : Thursday, £35 3s. 9d. ; Friday, £35 1s. 3d. ; Monday, £34 10s. ; Tuesday, £34 8s. 9d. ; Wednesday, £34 11s. 3d.

The SHOTTS IRON COMPANY, Ltd.

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Approximate Analyses of SHOTTS PIG IRON

FOUNDRY AND FORGE QUALITIES.

	Iron.	Graphitic Carbon.	Combined Carbon.	Silicon.	Sulphur.	Phos.	Mang.
	%	%	%	%	%	%	%
No. 1	91.38	3.30	.25	3.25	.02	.70	1.10
No. 3 Soft	91.67	3.40	.20	2.90	.03	.70	1.10
No. 3 Medium	91.95	3.25	.35	2.60	.05	.70	1.10
No. 3 Hard	92.49	3.00	.45	2.30	.06	.70	1.00
No. 4 Soft	93.03	2.90	.50	1.80	.07	.70	1.00
No. 4 Hard	93.60	2.75	.65	1.40	.10	.70	.90
Mottled	93.95	2.00	1.50	.90	.15	.70	.80
White	94.35	.60	2.80	.55	.30	.70	.70

Compositions other than the above supplied to specification.

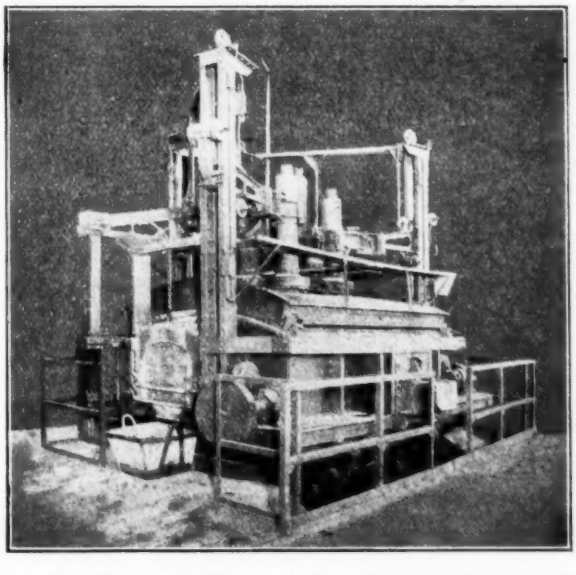
In addition to PIG IRON we are producers of the following :—

Coal for Steam, Gas and Household purposes.
Limestone for Blast Furnaces and Foundries.
Lime for Building, Agricultural Purposes, etc.
Slag for Ballasting and Road Making broken to sizes to suit purchasers.
Shotts Brick for Building Purposes.

GREAVES-ETCHELLS ELECTRIC STEEL FURNACES

MORE THAN 100 FURNACES SUPPLIED DURING LAST 7 YEARS.

WATSON ROTATING ELECTRIC FURNACES Ensure RAPID & CLEAN MELTING — THOROUGH MIXING.



NON-FERROUS METAL MELTING ELECTRIC FURNACES — SINGLE, TWO, or THREE PHASE.

CONTRACTORS TO HOME AND FOREIGN GOVERNMENTS.

WATSONS (METALLURGISTS) LIMITED

Lancaster Street, SHEFFIELD

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	58	15	0
Three months	59	17	0
Electrolytic	65	0	0
Tough	62	0	0
Best selected	63	0	0
Sheets	90	0	0
India	75	0	0
Wire bars	65	10	0
Do. Jan.	65	2	6
Do. Feb.	65	2	6
Ingot bars	65	2	6
H.C. wire rods	69	10	0
Off. av. cash, Dec. 59	12	0	$\frac{6}{11}$
Do., 3 mths. Dec. 60	12	10	$\frac{1}{11}$
Do., Sttlmnt, Dec. 59	11	9	$\frac{9}{11}$
Do., Electro, Dec. 65	16	8	$\frac{5}{11}$
Do., B.S., Dec.	64	7	0
Aver. spot price copper, Dec.	59	11	10
Do., wire bars, Dec. 66	0	11	
Solid drawn tubes		13d.	
Brazed tubes		13d.	
Wire		10d.	

BRASS.

Solid drawn tubes	12d.
Brazed tubes	13½d.
Rods, drawn	11½d.
Rods, extd. or rlld.	7½d.
Sheets to 10 w.g	10½d.
Wire	10½d.
Rolled metal	9½d.
Yellow metal rods	7½d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets	8½d.

TIN.

	£	s.	d.
Standard cash	279	0	0
Three months	274	5	0
English	277	0	0
Bars	280	5	0
Straits	280	5	0
Australian	279	15	0
Eastern	282	0	0
Banca	282	15	0
Off. aver. cash, Dec. 285	1	0	$\frac{1}{2}\frac{5}{2}$
Do., 3 mths., Dec. 279	3	8	$\frac{7}{2}\frac{5}{2}$
Do., Sttlmt. Dec. 285	0	5	$\frac{5}{11}$
Aver. spot., Dec. 285	0	5½	

SPELTER.

	£	s.	d.
Ordinary	37	16	3
Remelted	36	10	0
Hard	31	10	0
Electro 99.9	41	0	0
English	38	7	6
India	32	15	0
Zinc dust	46	0	0
Zinc ashes	15	0	0
Off. aver., Dec.	37	17	$9\frac{9}{2}\frac{5}{2}$
Aver., spot, Dec.	38	6	6½

LEAD.

	£	s.	d.
Soft foreign ppt.	34	11	3
English	35	15	0
Off. average, Dec.	34	11	$10\frac{3}{2}\frac{7}{5}$
Average spot, Dec.	34	14	9½

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	46	0	0
Do. V.M. ex whf.	44	10	0
Rods	51	0	0
Boiler plates	44	0	0
Battery plates	44	0	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	104	10	0
Chinese	93	0	0
Crude	62	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	15	2	6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro silicon 25%	9	10	0
45/50%	11	2	6
75%	21	15	0
Ferro-vanadium— 35/40%	15/3 lb. va.		
Ferro-molybdenum— 70/75% c. free	6/1 lb.		
Ferro-titanium— 23/25% carbonless	1/1 lb.		
Ferro-phosphorus, 20/25%,	£19	10	0
Ferro-tungsten— 80/85%, c.fr. 1/10 lb. to	1/10½		
Tungsten metal powder— 98/99%	2/1 lb.		
Ferro-chrome— 2/4% car.	£34	5	0
4/6% car.	£23	5	0
6/8% car.	£22	15	0
8/10% car.	£22	5	0
Ferro-chrome— Max. 2% car.	£40	10	0
Max. 1% car.	£47	10	0
Max. 0.70% car.	£56	10	0
70%, carbonless	1/5 lb.		
Nickel—99%, cubes or pellets	£172 to £177		
Cobalt metal—98/99%	10/- lb.		
Aluminium 98/99%	£123		
Metallic Chromium— 96/98%	3/9 lb.		
Ferro-manganese (net)— 76/80%, loose	£15	7	6
76/80%, packed	£16	7	6
76/80%, export	£15	5	0
Metallic manganese— 94/96%, carbonless	2/- lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	s.	d.
Finished bars, 14% tungsten	2	6
Finished bars, 18% tungsten	3	0

Per lb. net, d/d buyers' works.

Extras—
Rounds and squares 3 in. and over — 4d. lb.
Rounds and squares under ½ in. to ¼ in. 3d. lb.
Do. under ¼ in. to $\frac{3}{16}$ in. — 1/- lb.
Flats, ¼ in. × ¼ in. to under 1 in. × ⅜ in. 3d. lb.
Do. under ¼ in. × ¼ in. 1/- lb
Bevels of approved sizes and sections 6d. lb.
Bars cut to length 10% extra

Scrap from high-speed tool steel—
Scrap pieces — 3d.
Turnings and swarf — 1d.
Per lb. net, d/s steel makers' work

SCRAP.

	£	s.	d.	£	s.	d.
South Wales— Hvy. steel	3	7	6	3	10	0
Bundled steel & shrngs.	3	2	6	to 3	6	0
Mixed iron & steel	3	2	6			
Heavy cast iron	3	2	6	to 3	5	0
Good machinery for foundries	3	8	6	to 3	10	0
Cleveland— Heavy steel		3	5	0		
Steel turnings		2	7	6		
Cast iron borings		2	3	6		
Heavy forge		4	2	6		
Bushelled scrap		3	7	6		
Cast-iron scrap		3	2	6		
Lancashire— Cast-iron scrap		3	12	6		
Heavy wrought		3	7	6		
Steel turnings		2	0	0		

London — Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	55	10	0
Brass (clean)	41	0	0
Lead (less usual draft)	31	5	0
Tea lead	27	0	0
Zinc	26	10	0
New aluminium cuttings	92	0	0
Braziery copper	45	0	0
Gunmetal	46	10	0
Hollow pewter	195	0	0
Shaped black pewter	145	0	0

PIG-IRON.

(*f.o.t. unless otherwise stated*).

N.E. Coast— Foundry No. 1	72/6
Foundry No. 3	70/-
Foundry No. 4	69/-
Forge No. 4	68/-
Hematite No. 1	78/-
Hematite M/Nos.	77/6
N.W. Coast— Hem. M/Nos. d/d Glas.	86/3
„ d/d Birm.	93/9
Midlands— Staffs com on*	—
„ No 4 forge	60/-
„ No. 3 foundry	67/-
Shrops. basic	70/-
„ Cold blast, ord.*	185/-
„ „ roll iron*	190/-
* d/d Birmingham.	
Northants forge	55/6
„ fdry No. 3	63/9
Derbyshire forge	60/-
„ fdry. No. 3	67/-
„ basic	65/-
Scotland— Foundry No. 1	81/6
„ No. 3	76/6
Hem. M/Nos.	76/6
Sheffield (d/d district)— Derby forge	64/-
„ fdry. No. 3	71/-
Lincs. forge	67/-
„ fdry. No. 3	69/-
E.C. hematite	87/6
W.C. hematite	90/6
Lincs. (at furnaces)— Forge No. 4	61/-
Foundry No. 3	63/-
Basic	62/-
Lancashire (d/d eq. Man.)— Derby forge	61/-
„ fdry. No. 3	63/-
Northants foundry No. 3	76/6
Dalzell, No. 3	110/-
Summerlee, No. 3	94/-
Glengarnock, No. 3	94/-
Gartsherrie, No. 3	94/-
Monkland No. 3	94/-
Coltness, No. 3	94/-
Shotts, No. 3	94/-

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	11	5	0	to 12	10	0
Angles				11	10	0
Tees to 3 united ins.				12	0	0
Nut and bolt				10	15	0
Hoops	14	0	0	to 15	0	0
Marked bars (Staffs.) f.o.t.				14	0	0
Gas strip	12	10	0	to 12	15	0
Bolts and nuts ¾ in. × 4 in.				16	15	0
Steel— Ship plates	7	7	6	to 7	17	6
Boiler plts.				11	10	0
Chequer plts.	£9	5	0	to 9	15	0
Angles	£7	0	0	to 7	5	0
Tees	£8	0	0	to 8	5	0
Channels	£6	12	6	to 7	2	6
Joists	£7	0	0	to 7	5	0
Rounds and Squares 3 in. to 5½ ins.				8	0	0
Rounds under 3 in. to ⅜ in.				7	15	0
Flats, over 5 in. wide and up				8	10	0
Flats, 5in. to 1½in.				7	10	0
Rails, heavy				8	0	0
Fishplates				12	0	0
Hoops (Staffs.)				10	10	0
Black sheets, 24g.				11	5	0
Galv. cor. sheets, 24g.				16	15	0
Galv. fencing wire 8g. plain				14	0	0
Billets, soft	£6	0	0	to 7	5	0
Billets, hard				8	2	6
Sheet bars				6	5	0
Tin bars d/d				6	5	0

PHOSPHOR BRONZE.

	Per lb.	basis.
Strip	1	3
Sheet to w.g.	1	3½
Wire	1	3¾
Rods	1	3
Tubes	1	8½
Castings	1	2

Delivery 3 cwt. free
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled— To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/- to 1/8½
Wire round— 3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	24.26
No. 2 foundry, Valley	22.26
No. 2 foundry, Birm.	22.00
Basic	21.76
Bessemer	22.76
Malleable	22.26
Grey forge	21.76
Ferro-mang. 80% d/d	115.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess billets	36.00
O.-h. billets	36.00
O.-h. sheet bars	37.00
Wire rods	45.00
	Cents.
Iron bars, Phila.	2.22
Steel bars	2.00
Tank plates	1.90
Beams, etc.	1.90
Skelp, grooved steel	1.90
Skelp, sheared steel	1.90
Steel hoops	2.50
Sheets, black, No. 28	3.35
Sheets, galv., No. 28	4.00
Sheets, blue an'l'd, 9 & 10	2.50
Wire nails	2.65
Plain wire	2.50
Barbed wire, galv.	3.35
Tinplate, 100 lb. box	$5.50

COKE (at ovens).

Welsh foundry — 32/6 to 37/6
„ furnace — 20/- to 25/-
Durham & North.
„ foundry — 30/- to 33/-
„ furnace — 18/-
Other Districts, foundry — 30/- to 33/-
„ „ furnace (basis) — 11/9

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes, 20×14, box		19/9
„	28×20, „	39/6
„	20×10, „	29/-
„	18¾×14, „	20/6
C.W.	20×14, „	18/-
„	28×20, „	36/-
„	20×10, „	24/9
„	18¾×14, „	18/6

Terneplates 28×20, 36/- per box basis f.o.b.

SWEDISH IRON.

Bars, hammered	£19/0 to £20/0
Rolled Ord.	£16/0/0 to £16/10/0
Nail rods	£16 5 0 to £16 15 0
Keg. steel nom.	£33 to £35
Faggot steel nom.	£22 to £25
Blooms, according to quality	£9 to £12
Pig-iron	£6 15 0 to £7 0 0

all f.o.b. Gothenburg.

TUBES AND FITTINGS.

Up to and incl. 6 in.

	Tubes	*Fittings*
Gas	60%	50%
Water	55%	45%
Steam	50%	40%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (Cash).

	£	s.	d.		
Jan. 14	59	7	6	dec.	2/6
,, 15	59	7	6	No change	
,, 18	58	15	0	dec.	12/6
,, 19	58	15	0	No change	
,, 20	58	15	0	,, ,,	

Electrolytic Copper.

	£	s.	d.		
Jan. 14	65	15	0	dec.	5/-
,, 15	65	10	0	,,	5/-
,, 18	65	0	0	,,	5/-
,, 19	65	0	0	No change	
,, 20	65	0	0	,, ,,	

Standard Tin (Cash).

	£	s.	d.		
Jan. 14	283	15	0	dec.	65/-
,, 15	283	10	0	,,	5/-
,, 18	281	0	0	,,	50/-
,, 19	279	5	0	,,	35/-
,, 20	279	0	0	,,	5/-

Tin (English ingots).

	£	s.	d.		
Jan. 14	283	0	0	dec.	50/-
,, 15	282	15	0	,,	5/-
,, 18	280	0	0	,,	55/-
,, 19	278	5	0	,,	35/-
,, 20	277	0	0	,,	25/-

Zinc Sheets (English).

	£	s.	d.		
Jan. 14	46	0	0	No change	
,, 15	46	0	0	,, ,,	
,, 18	46	0	0	,, ,,	
,, 19	46	0	0	,, ,,	
,, 20	46	0	0	,, ,,	

Spelter (ordinary).

	£	s.	d.		
Jan. 14	38	13	9	dec.	1/3
,, 15	38	10	0	,,	3/9
,, 18	37	15	0	,,	15/-
,, 19	37	12	6	,,	2/6
,, 20	37	16	3	inc.	3/9

Lead (English).

	£	s.	d.		
Jan. 14	36	10	0	No change	
,, 15	36	5	0	dec.	5/-
,, 18	35	15	0	,,	10/-
,, 19	35	15	0	No change	
,, 20	35	15	0	,, ,,	

Exports of Iron Castings in December and the twelve months, 1925, compared with December and the twelve months, 1924.

	Dec., 1924	Dec., 1925	Twelve months, 1924	Twelve months, 1925	Dec., 1924	Dec., 1925	Twelve months, 1924	Twelve months, 1925
BUILDERS' CASTINGS:— Stoves, Grates, etc., Cisterns, Baths, etc., and cooking and washing boilers:—	Tons.	Tons.	Tons.	Tons.	£	£	£	£
To Argentine Republic	98	128	1,434	1,582	3,487	4,419	51,161	58,100
,, British South Africa	270	291	3,255	3,792	8,883	10,071	111,394	132,162
,, ,, East Indies	131	149	1,377	1,749	6,526	6,644	58,789	78,938
,, Australia	74	55	826	748	3,431	3,220	45,333	42,079
,, New Zealand	193	314	2,242	2,852	9,699	15,466	109,586	133,101
,, Other countries	737	929	6,869	8,418	38,241	48,839	344,968	429,381
Total	1,503	1,866	16,004	19,141	70,267	88,659	721,231	873,761
PIPES AND FITTINGS:— Cast—								
To Argentine Republic	625	379	8,785	10,419	8,856	5,116	123,296	134,290
,, British South Africa	240	382	6,543	6,040	3,450	6,611	87,108	89,574
,, ,, India	984	1,225	11,417	10,179	13,466	16,664	166,953	144,333
,, Straits Stt'mts. & Malay States	123	788	8,034	6,206	2,911	8,375	102,375	71,556
,, Ceylon	244	228	1,261	1,524	2,833	2,896	17,107	19,152
,, Australia	337	211	4,266	3,055	4,220	3,121	65,384	48,267
,, Other countries	3,860	6,508	44,132	56,828	61,813	98,925	744,404	841,728
Total	6,413	9,721	84,438	94,251	97,549	141,708	1,306,627	1,348,900
HOLLOW-WARE:—								
Cast, not Enamelled, & Cast, Tinned	678	676	6,815	8,195	25,353	23,822	267,567	279,095
,, Enamelled	87	92	1,069	1,035	10,055	8,317	111,229	104,281
CASTINGS in the rough:—								
Iron	138	142	1,537	1,694	3,906	5,009	61,057	59,559
Steel	49	68	2,154	939	2,767	2,913	45,689	38,634

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

18, BENNETTS HILL, BIRMINGHAM.
11, OLD HALL STREET, LIVERPOOL.
EXCHANGE BLDGS., PORT TALBOT.
FOWLERS BUILDINGS, BOMBAY.
CLIVE STREET, CALCUTTA.
ANGAPPA NAICK STREET, MADRAS.

REGISTERED TRADE MARK

1, HONG KONG ROAD, SHANGHAI.
OCEAN BUILDING, SINGAPORE.
JAVA STREET, KUALA LUMPUR
5, SHAFFRAZ ROAD, RANGOON.
COX'S BUILDINGS, KARACHI.
P.O. BOX 1580, CAIRO.

PIG IRON

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.,

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM COLVIN & COMPANY,

ROYAL EXCHANGE, MIDDLESBROUGH.

93, HOPE STREET, GLASGOW.

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 7 words per line. Minimum charge for one insertion 3/-.

SITUATIONS VACANT AND WANTED.

MOULDER or COREMAKER, 20 years of first-class Foundry experience, including Cupola practice, seeks regular job, anywhere; Advertiser would help at anything and give his knowledge for a constant situation in country; low wage taken to be settled down.—PAIGE, 19, The Vale, Acton, W.3.

FIRST-CLASS, PRACTICAL, ALL-ROUND FOUNDRY-MAN desires position, to take control; Ferrous or Non-Ferrous; specialises in both Metals.—Box 598. Offices of THE FOUNDRY TRADE JOURNAL, 5, Duke Street, Adelphi, London, W.C.2.

AN UNDER FOREMAN required to take charge of a small Casting Department. He must have had experience in the handling of men and boys, also the working of Moulding Machines and use of Metal Patterns. Apply in first instance by letter stating wages required, age and full experience, in confidence to M.D., Suffolk Iron Foundry (1920), Ltd., Stowmarket.

EX-OFFICERS AND OTHER RANKS.

The Proprietors of the FOUNDRY TRADE JOURNAL have placed this space at the disposal of the British Legion, Officers' Association, Employment Bureau, 3-4, Clement's Inn, Strand, London, W.C.2. (telephone: Holborn 5769), to whom all replies should be addressed, quoting number of advertisement, date on which it appeared, and the name of this paper.

VACANCY required in Works, Electrical or Mechanical; considerable experience Instrument manufacture; keen; excellent references; disciplinarian; suit control department, manufacture or maintenance. (4439)

SALESMAN, well educated, energetic, late R.A.S.C., in charge of stores, seeks post in country; 14 years with one firm in London, previous to September, 1914. (740)

MECHANICAL ENGINEER, age 35, steam, gas and oil, desires post, preferably at home; wide experience; installation of plant, erection, and maintenance factories, etc.; sound knowledge of draughtsmanship and design; considerable commercial experience; speaks French, Swahili; keen and energetic. (361)

MOTOR ENGINEER: 10 years' experience with Motors, Aero Engines and Electrical Apparatus, including three years as a Lecturer and Demonstrator: Sales experience; can produce first-class references. (3222)

ENGINEER, age 27, requires situation, preferably abroad; workshop and drawing-office training; experience with Gas and Oil Engines and Plant Maintenance; knowledge of French; salary of small importance with good prospects. (Dis. 56)

MACHINERY

DRILLING AND BORING MACHINES.

One Horizontal DRILLING AND TAPPING MACHINE; spindle, 3½ in. diameter x 14 in.; standard, 5 ft. high; T-slotted Table, 3 ft. x 3 ft.; in addition, Swivelling Table on top, 3 ft. x 3 ft. x 4½ in. deep; modern tool; by Tullis.

One Horizontal BORING MACHINE, Noble & Lund; standard, 6 ft. high; spindle, 3½ in. diameter; Slotted Bed in front, 14 ft. x 6 ft.; in excellent condition.

One Horizontal BORING AND FACING MACHINE, by Noble & Lund; to face 36 in.; Rising and Falling Bed, 5 ft. x 2 ft. 6 in.; Saddle on top of bed, with T-slotted Table, 3 ft. x 2 ft. 9 in.; excellent condition.

For prices and further particulars, write Box 592, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

SAND MIXERS.—New and second-hand. Ask us to quote.—W. BREALEY & COMPANY, LTD., Russell Street, Sheffield.

MACHINERY.—*Continued.*

"OLIVER." No. 75. MECHANICAL PATTERN MAKER, and Universal Wood Milling Machine, second-hand, but having had little use, is equal to new, complete with full set of tools, accessories, etc.; great bargain at very low price; photo.—Apply, FRED BROWN & SON, LIMITED. North Road Works, St. Helens.

FOR SALE.—20-in. and 24-in. Hall's Invincible Sand Mixers; the original and best machine in the market for mixing old and new Foundry Sand, Coal Dust, etc.—Apply, PENNEY & PORTER (ENG.), LTD., Lincoln.

IF YOU ARE WANTING

LATHES AND CAPSTANS.

ASK FOR BLUE CATALOGUE.

No. 147.

NEW AT HALF-COST PRICES.

CATALOGUE (10,000 LOTS) ON APPLICATION.

THOS W. WARD, LTD.,

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